The Revised Nevada Bat Conservation Plan

The Nevada Bat Working Group

2006








Abstract

The Nevada Bat Working Group (NBWG), a subcommittee of the Western Bat Working Group (WBWG) is an assemblage of wildlife scientists dedicated to the preservation, protection, management and restoration of Nevada's bat fauna. In 1998, the NBWG dedicated itself to the production of a comprehensive conservation plan for Nevada's 23 bat species. A plan was initially completed in 2002. This current plan represents a complete revision and update of the 2002 plan. The plan assesses the current state of bat conservation in Nevada and suggests proactive strategies for improving and standardizing the conservation of Nevada's bats. The plan profiles each species and cross-references conservation strategies by roosting and foraging habitats specific to each bat. Conservation support materials in the form of research need summaries, survey protocols, permit requirements, standardized data collection sheets, approved gate and bridge designs, current and proposed legislation, as well as NBWG habitat position statements were appended for ease of retrieval for managers charged with the stewardship of Nevada's bat resource. This document is designed to guide and educate public and private land managers in the conservation of Nevada's bats into the next decade. Signatories have dedicated their agencies to the spirit of the plan and will do their best to conserve bats and bat resources within their jurisdictions. It is the intent of the NBWG that this plan is seen as a dynamic document with periodic review and complete revisions on a ten-year cycle to reflect improvements in the knowledge base of bat conservation in the State of Nevada.

KEY WORDS: Nevada, bats, conservation, habitat, *Chiroptera*.

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SIGNATURE PAGE

Whereas, the conservation of Nevada's biological diversity is one of the cornerstones of our quality of life,

Therefore, we the undersigned agree to work toward the conservation of Nevada's bat fauna through a good faith effort to implement the tenets of this plan. This plan shall be revised once every ten years to incorporate new information and better methods towards the conservation of bats and bat resources.

APPROVED: **Date**

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EXECUTIVE SUMMARY

This document is a product of several years of research, planning and discussions by dozens of wildlife scientists dedicated to the conservation of Nevada's bats. Individuals from several jurisdictions came together with a common purpose, a commitment to the long-term preservation, protection, management and restoration of bat populations in the State. This document is intended to be a dynamic model for the conservation of Nevada's bat fauna far into the next decade.

The Nevada Bat Conservation Plan was created by the Nevada Bat Working Group, which in turn is part of the Western Bat Working Group (WBWG) and The North American Bat Conservation Partnership (NABCP). NABCP is an alliance of four regional working groups from Mexico, Canada, and the United States. The NABCP was created to support continent-wide bat conservation efforts in an organized way. The NABCP's four regional working groups include: the Northeastern Bat Working Group, Southeastern Bat Diversity Network, Mexico Bat Working Group, and the Western Bat Working Group (WBWG). The WBWG is a coalition of state bat working groups from 13 Western states (including the Nevada Bat Working Group) and the Canadian provinces of British Columbia and Alberta. The WBWG steering committee includes a core group of individuals and representatives from each of the state working groups.

This document provides a summary of the known biological characteristics of each of Nevada's 23 species of bats. Following the biological profiles are habitat guilds including various roosting sites, foraging sites, and water resources. Each guild includes specific goals and actions for species that may occur in that guild. Education and research needs are also addressed in the plan and the appendices provide technical information on a variety of subjects relating to the tenets of the plan.

We envision that this plan will be completely reviewed and updated every 10 years. In the meantime, the Nevada Bat Working Group will continue to meet at least once a year to review annual updates to the plan, document annual progress, implement adaptive management practices, and coordinate research, inventory, monitoring, and educational efforts. Implementation of specific tasks and funding for such tasks will come, as it has in the past, from a variety of resources, agencies, and personnel. Data on all of Nevada's bat species will be housed at the Nevada Natural Heritage Program and the Nevada Department of Wildlife.

Signatories to the plan have agreed to work towards the conservation of Nevada's bat fauna in a collaborative effort. Although the conservation of Nevada's 23 bat species are complicated by complex biological, ecological, and practical management constraints, we believe that by working together, we can make positive strides in conserving this important guild of mammals.

ACKNOWLEDGMENTS

A big thank you goes out to several individuals and agencies for their moral and financial support of the Nevada Bat Working Group and in the initiation, production and eventual distribution of this document. They include:

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Laura Richards, NDOW, Reno

CONSERVATION ASSESSMENT

Introduction

This Conservation Plan applies to 23 bat species within the State of Nevada. The purpose of this Plan is to reduce the threats to bat populations and their habitats within Nevada's borders and is intended to diminish the likelihood that any bat species in Nevada will require protection under the Endangered Species Act. Recognizing that Nevada's bats are part of a much larger ecosystem, the goal of the Plan is to promote healthy bat habitats and stable and/or increasing bat populations throughout western North America.

Landscape Description

Nevada is the seventh largest State in the Union, covering 110,540 square miles. Our State also has the distinction of being the driest as well as the most mountainous. Habitats range from the Mojave Desert in the south to alpine tundra on several mountains throughout the State. Salt desert shrub (*Atriplex* sp.), sagebrush steppe (*Artemisia* sp.), wetland (*Scirpus* sp.), pinyon/juniper/mahogany woodland (*Pinus monophylla, Juniperus* sp., *Cercocarpus* sp.), mountain brush (*Amelanchier* sp.), willow/cottonwood/aspen riparian (*Salix* sp., *Populus* sp.), and subalpine coniferous forest of pine, fir and spruce (*Pinus* sp., *Abies* sp., *Pseudotsuga* sp., *Picea* sp.) habitats fill the gap between hot deserts and cold alpine mountain peaks (Munz, 1973). Extreme differences in elevation (200-4,000 meters) and latitude (35-42 degrees), rain shadow and storm track influences, as well as geological variability in parent rock materials have provided a grand mosaic of habitats throughout Nevada. The habitat diversity displayed by this mosaic contributes to Nevada's distinction of being ranked 11th in the Nation in terms of its biological diversity (Stein, 2002). Nevada's bat fauna mirrors this biological diversity – of the 40 species in the U.S. and Canada, 23 occur in Nevada. Bats inhabit or utilize many niches across the Nevada landscape. These include caves, abandoned mines, cliffs, springs, riparian, aspen, pinyon-juniper, subalpine coniferous forest, and desert shrub habitats (Ports and Bradley, 1996; Kuenzi et al., 1999; Sherwin et al., 2000a; Williams, 2001).

Bat Conservation in Nevada - A Brief History

Aside from an inadvertent introduction of bats from Sacramento into the Virginia City area in 1858 (Covington, 1976), bat conservation is a relatively new phenomenon in the field of conservation biology in the State of Nevada. In 1985, along with several other "undesirable" mammalian species, the entire order of *Chiroptera*, with the exception of the spotted bat, was assigned the status of "unprotected mammal" in Nevada. Similar to the black-tailed jackrabbit, the valley pocket gopher, the coyote, the house mouse and the Norway rat, there was no protection afforded these species. Recently, in 2004, the Nevada State Legislature provided protection for an additional 8 species of bats, classifying them as protected, sensitive, or threatened. Currently, 15 of 23 Nevada bat species remain unprotected.

Bat conservation was first discussed in earnest in 1946 with the publication of *Mammals of Nevada* (Hall, 1976). Hall provided the first species accounts and distribution maps based on empirical data for 18 bat species in the State. He also provided the first sound arguments for a conservative treatment of this order of mammals in Nevada:

> "The population of most species of bats is maintained by the birth of only one young per year, whereas most other kinds of mammals must necessarily produce far more young to maintain themselves...and...Bats usually return annually to the same caves to hibernate. Destruction of every individual in a wintering colony therefore might have more lasting effect on the number of bats than it would if

> they were less provincial...and...The many popularly held superstitions about bats generally prove upon experiment to be groundless...and... Only the deeper caves and mine tunnels are suitable as winter quarters for the [bats] that hibernate, because they require a temperature above freezing."

Indiscriminate closure of abandoned mines is recognized as a threat to bats and their habitats. Today, an attempt is being made to provide input to closure plans for the roughly 300,000 mine openings based on recent empirical data. Three of Nevada's most significant bat roosts on record occupy historical mine workings, i.e. 1) the largest known Townsend's big-eared bat (*Corynorhinus townsendii*) hibernation roost in Nevada (White Pine County), 2) the largest known western small-footed Myotis bat (*Myotis ciliolabrum*) hibernation roost in Nevada (Eureka County), and 3) Nevada's largest known pallid bat (*Antrozous pallidus*) maternity roost (Pershing County).

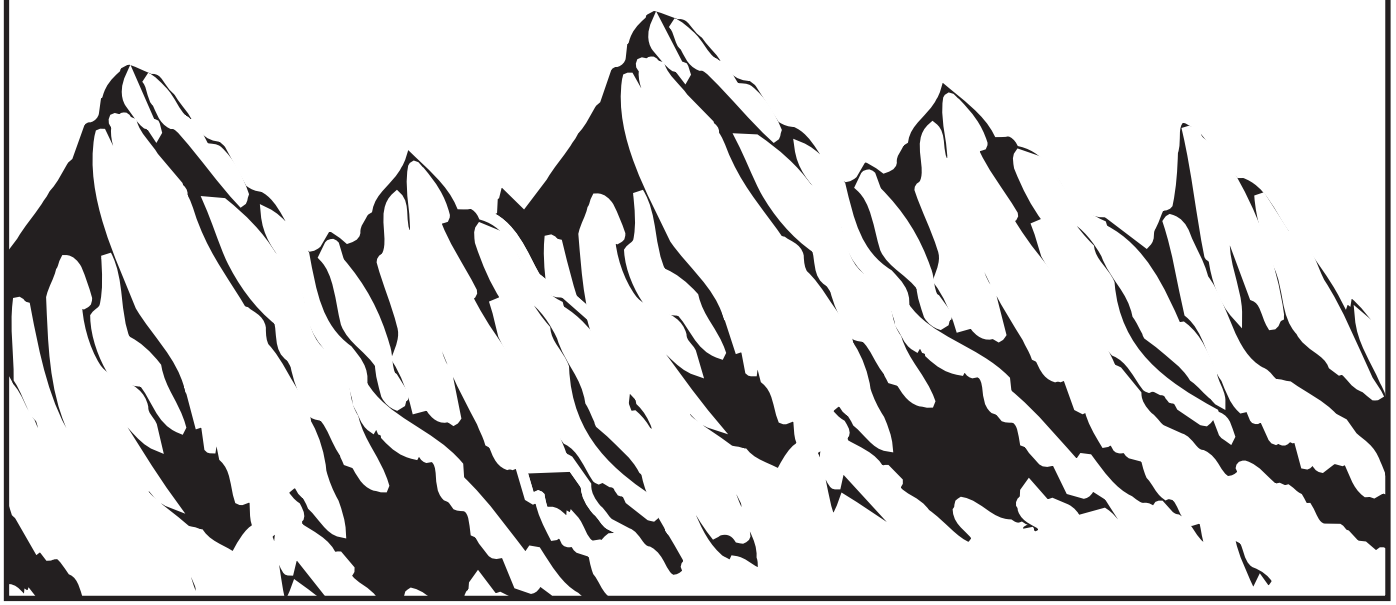
Several additional threats to the long-term stability of bat populations continue to surface. The lack of accurate information/education dissemination is perhaps the most insideous and damaging to the bats' public relations image and ultimately to the conservation of this order of mammals. For example, the State Health Lab continues to provide the statistic that 10-15% of all bats carry the rabies virus, which comes with the added baggage of all bats being placed on a *State Vector List* of disease-carrying animals. This estimated statistic is based on a biased sample of injured and/or sick, and therefore easily captured, individual bats that make their way to the lab for rabies testing. The normal background incidence of rabies in North American bats is less then 0.5% (Constantine, 1979). By comparison, the greatest incidence of rabies infection continues to be found in racoons and skunks. In 2001, 7437 cases of rabid animals were reported to the CDC. Raccoons were 37.2%, skunks 30.7%, bats 17.2%, cats 3.6% and dogs 1.2% (CDC, 2002). While the greatest incidence of rabies in wildlife may be in other mammals, bats were the source of 14 out of 18 human rabies cases in the U.S. between 1980 and 1994 (CDC, 1995). This is likely due to people attempting to pick up or handle a sick bat, as rabid bats are rarely aggressive when left alone. To put this into perspective, more people die annually from dog bites than have died from rabid bat bites in a decade. Statistically speaking, pets, playground equipment, and sports are far more dangerous than bats (BCI, 2003). Nevertheless, prudence and simple precautions can save lives. It is in the best interest of all Nevadans and the bat resource that rabies education be continued. However, this education process should be made fair and accurate and put into the proper context. The North American Symposium on Bat Research, with a broad membership, has created a resolution concerning bats and rabies that speaks to this issue (Appendix D).

Since Hall's work in the 1930s and 40s, five additional bat species have been documented in Nevada and range distribution maps for all species have been greatly enhanced. Bat survey and inventory techniques have become less intrusive and more accurate and sophisticated. Conservation of critical roosting habitats has commensed, foraging habitats are being identified with ever-icreasing accuracy and conservation education is in full swing in many parts of the State. Still, as Hall pointed out in 1946, we are dealing with a group of 23 species that share characteristics, beyond leather wings, which make them some of the most sensitive animals we manage. First, they are, in many cases, extremely rare. Second, they are often thinly distributed across the landscape. Third, most spend a good part of their summers clumped in caves, adits, shafts, tree trunks, behind exfoliating bark and incessantly circling water sources. Therefore, they put many of their "eggs in only a few baskets". Fourth, they spend their relatively long lives giving birth to only one or two young per year. Fifth, most do not migrate long distances, but rather congregate during winter to hibernate. For these reasons, scientists and managers need to proceed with caution and in the best interest of Nevada's bat populations. The ecological, economic and human health benefits Nevada realizes from their role as primary predators on insect pests may reach into the millions of dollars.

"So much remains to be learned about them and so little is known that they well repay study."

E. R. Hall, 1946

Bat Species
Profiles







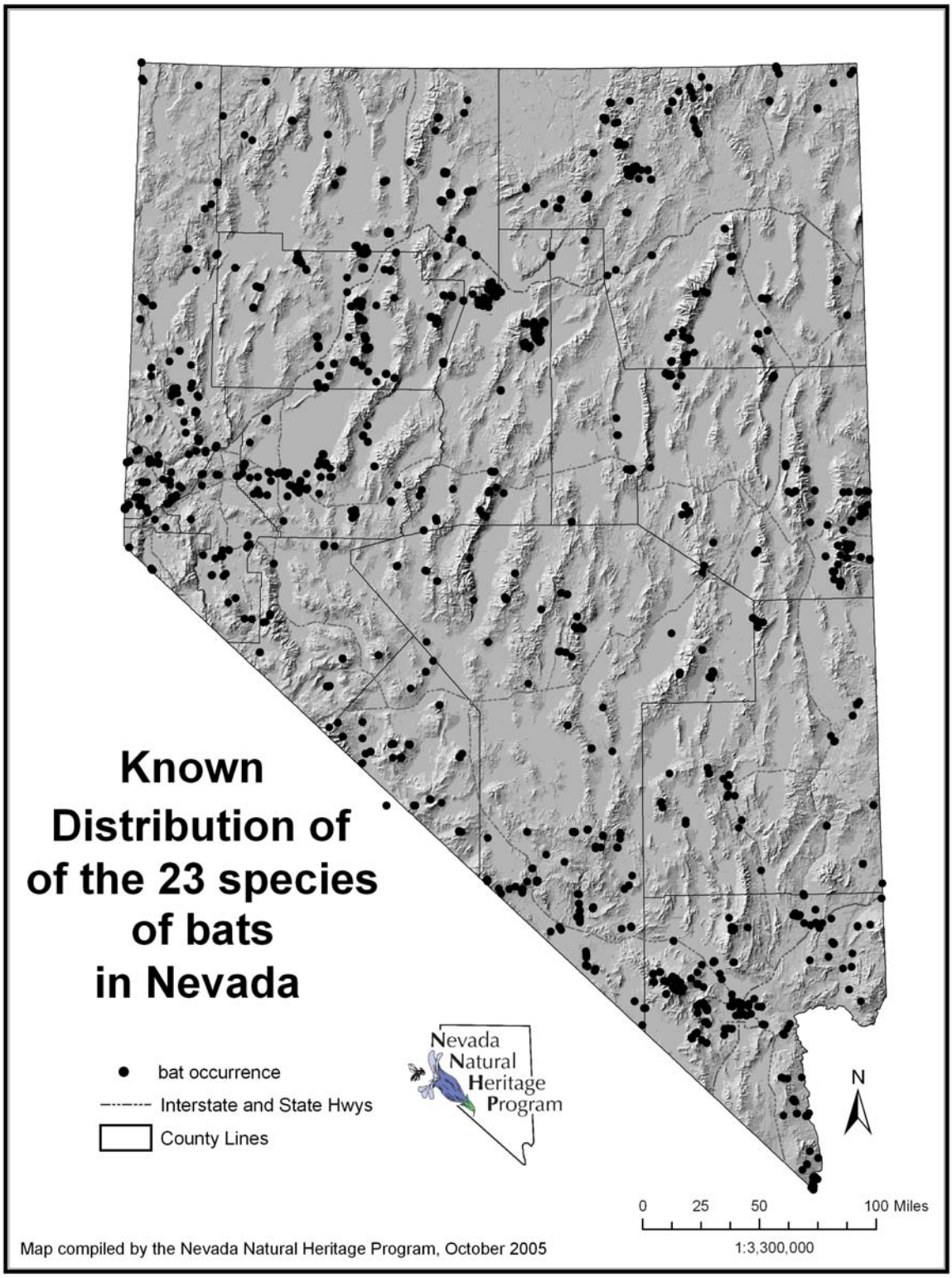



Species Profiles

Taxonomic Checklist of Nevada Bats and Habitat Conservation Guild Cross-Reference

FAMILY / SPECIES	COMMON NAME	HABITAT CONSERVATION GUILDS
Phyllostomidae		
Choeronycteris mexicana	Mexican long-tongued bat	CA, WS
Macrotus californicus	California leaf-nosed bat	CA, WS, DW, BB
Vespertilionidae		
Antrozous pallidus	pallid bat	CA, CL, TR, BB, WS, DW
Corynorhinus townsendii	Townsend's big-eared bat	CA, CL, TR, BB, WS, FW
Eptesicus fuscus	big brown bat	CA, TR, BB, WS, FW, CL
Euderma maculatum	spotted bat	CL, BB, WS, FW, DW, CA
Idionycteris phyllotis	Allen's big-eared bat	TR, CA, WS, FW, DW
Lasionycteris noctivagans	silver-haired bat	TR, CA, WS, FW, CL, BB
Lasiurus blossevillii	western red bat	TR, WS, FW
Lasiurus cinereus	hoary bat	TR, FW, WS
Lasiurus xanthinus	western yellow bat	TR, WS, FW
Myotis californicus	California myotis	CA, CL, TR, BB, WS, DW, FW
Myotis ciliolabrum	western small-footed Myotis	CA, CL, TR, FW, WS
Myotis evotis	long-eared myotis	TR, CA, FW, WS, CL, BB
Myotis lucifugus	little brown bat	TR, BB, WS, CL, CA, FW
Myotis thysanodes	fringed myotis	CA, TR, BB, WS, DW, FW, CL
Myotis velifer	cave myotis	CA,WS, BB, FW
Myotis volans	long-legged myotis	TR, CA, CL,WS, FW, BB
Myotis yumanensis	Yuma myotis	TR, BB, WS, CA, CL, FW
Pipistrellus hesperus	western pipistrelle	CL, CA, WS, BB, DW,
Molossidae		
Eumops perotis	western mastiff bat	CL, WS, FW
Nyctinomops macrotis	big free-tailed bat	CL, CA, WS, FW, BB
Tadarida brasiliensis	Brazilian free-tailed bat	CA, CL, BB, TR, WS, DW

BB Bridge and Building Roosting Habitat
CA Natural Cave, Mine Shaft and Adit Roosting Habitat
CL Cliff, Crevice and Talus Roosting Habitat
DW Desert Wash Foraging Habitat
FW Forest and Woodland Foraging Habitat
TR Tree Roosting Habitat
WS Water Source Foraging and Watering Habitat


Known Distribution of of the 23 species of bats in Nevada
bat occurrence
Interstate and State Hwys
County Lines
Nevada Natural Heritage Program
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0 25 50 100 Miles
1:3,300,000
Map compiled by the Nevada Natural Heritage Program, October 2005

Bat Species Risk Assessment in Nevada

Scientific Name	Common Name	Populations/Habitats At Risk
Choeronycteris mexicana	Mexican long-tongued bat	HIGH/EDGE OF RANGE
Macrotus californicus	California leaf-nosed bat	HIGH/EDGE OF RANGE
Antrozous pallidus	pallid bat	MODERATE
Corynorhinus townsendii	Townsend's big-eared bat	HIGH
Eptesicus fuscus	big brown bat	LOW
Euderma maculatum	spotted bat	MODERATE
Idionycteris phyllotis	Allen's big-eared bat	HIGH
Lasionycteris noctivagans	silver-haired bat	MODERATE
Lasiurus blossevillii	western red bat	HIGH
Lasiurus cinereus	hoary bat	MODERATE
Lasiurus xanthinus	western yellow bat	MODERATE/EDGE OF RANGE
Myotis californicus	California myotis	MODERATE
Myotis ciliolabrum	western small-footed Myotis	MODERATE
Myotis evotis	long-eared myotis	MODERATE
Myotis lucifugus	little brown bat	MODERATE
Myotis thysanodes	fringed myotis	HIGH
Myotis velifer	cave myotis	HIGH/EDGE OF RANGE
Myotis volans	long-legged myotis	LOW
Myotis yumanensis	Yuma myotis	MODERATE
Pipistrellus hesperus	western pipistrelle	MODERATE
Eumops perotis	western mastiff bat	MODERATE/EDGE OF RANGE
Nyctinomops macrotis	big free-tailed bat	MODERATE/EDGE OF RANGE
Tadarida brasiliensis	Brazilian free-tailed bat	LOW

Adapted from: *"Western Bat Species - Regional Priority Matrix" (*Western Bat Working Group, 1998) – See Appendix B for the entire Regional Priority Matrix.

Species Profile Texts and Range Maps for Nevada

Phyllostomidae

Choeronycteris mexicana— Mexican long-tongued bat

Distribution: Reaches northern limit of its range in southwestern U.S. Known only from a single individual found in Las Vegas. Recent collection of an individual on the Colorado River at 600 meters (m; C. Corben, personal communication) suggests the possibility of occasional occurrence.

Habitat Characteristics: Found in a variety of habitats in the Lower and Upper Sonoran life zones, from thorn scrub to tropical deciduous forests. Favors desert canyons with riparian vegetation.

Resident Status: Possible summer resident but more likely occasional transient.

Winter Status: Does not hibernate.

Roost Sites: Selects primarily mines, caves, and rock fissures for diurnal roosting. Also, sometimes in buildings. Prefers sites near the entrance in shade (i.e., twilight zone) rather than total darkness. Colony size can be up to 40-50 individuals, but more commonly is a dozen or fewer.

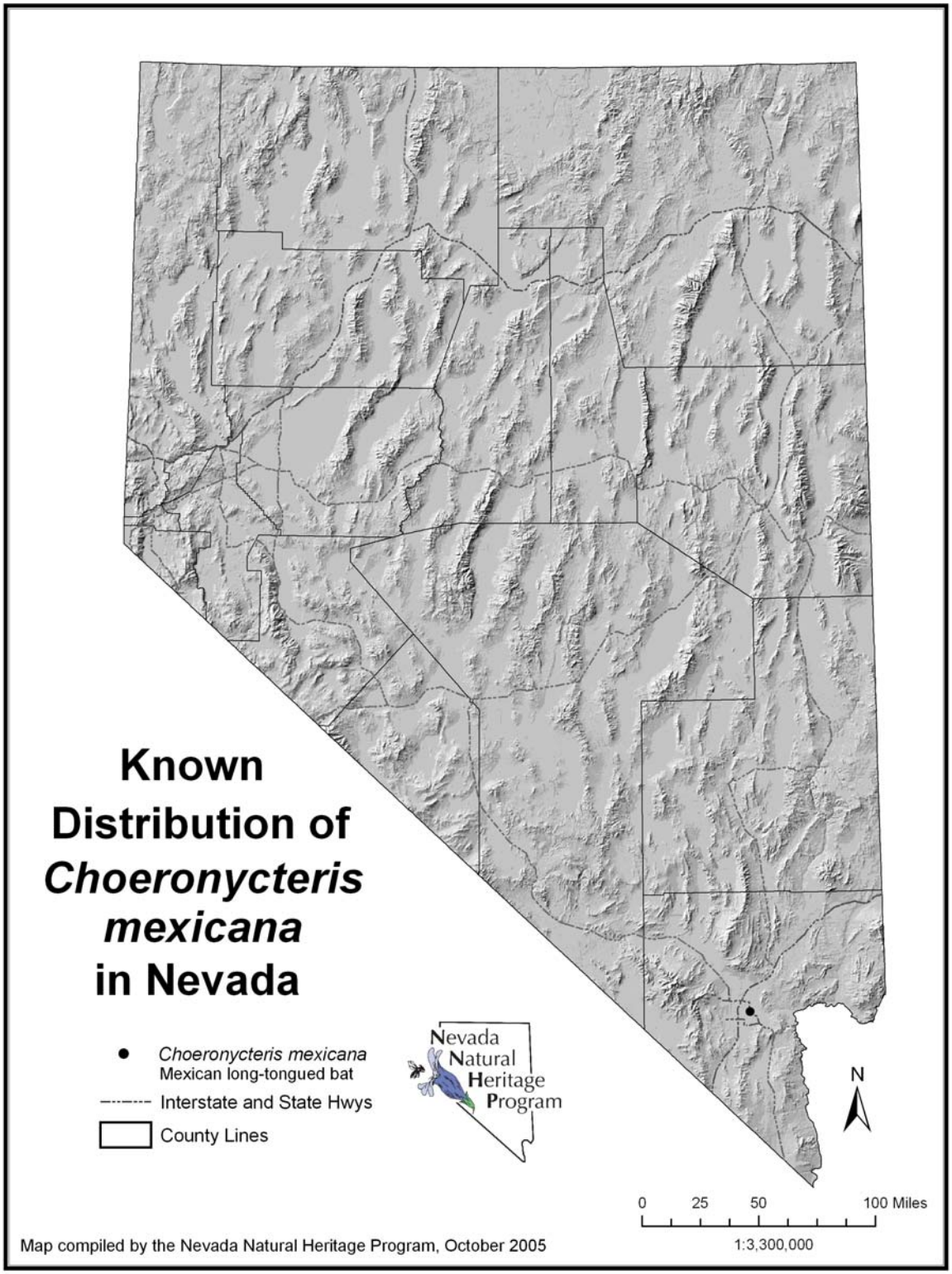
Reproduction: One young per year with birth occurring in June to July. Females congregate in maternity colonies.

Food Habits: Food items limited to pollen and nectar.

Current Nevada Status: State unprotected. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. NNHP: G4SA

Conservation/Management Issues: Recreational caving; natural or intentional mine closure; mine reclamation; renewed mining; water impoundments; availability of desert wash riparian vegetation. Behaviorally sensitive to roost disturbance.

Relevant References: Arroyo-Cabrales et al. (1987), Barbour and Davis (1969), Constantine (1987, 1988a), Cryan (2005), Fleming et al. (2003).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Map compiled by the Nevada Natural Heritage Program, October 2005

Macrotus californicus — California leaf-nosed bat

Distribution: Distribution is limited to the extreme southern portion of the state. Historical roosts in the Las Vegas Valley and along the Colorado River have been destroyed by vandalism, abandoned mine closure and inundation by the formation of Lakes Mead and Mojave. Only a few roosts are known to exist although there may be some foraging activity along the Virgin River based on Arizona reports from the confluence of Virgin River and Beaver Dam Wash. Recent capture of both sexes, including a pregnant female, in the Muddy River drainage (Williams, 2001) indicate presence of maternity roosts in the immediate vicinity. Although it is believed that this species does not migrate, local movements among roosts occur, particularly on a seasonal basis.

Habitat Characteristics: Low elevation desert scrub habitats. Roosts are located below 915 m elevation in proximity to desert riparian areas. Current Nevada records indicate this species is distributed between 210-690 m (mean = 391 m $\pm$ 195 m) primarily in creosote, Mojave scrub and riparian areas.

Resident Status: Year round resident.

Winter Status: Does not hibernate. Both sexes congregate together in specific, warm winter roosts. Year-round activity.

Roost Sites: Dependent on caves and mines for day roosting. Mines used as winter roosts have internal temperatures > 29° C, and are usually geothermally heated. More than one day roost may be used during the year. Night roosting occurs in a variety of places, including buildings, cellars, porches, bridges, rock shelters, and mines. Summer colonies may range from 6 to several hundred individuals, with winter colonies containing 100 to over 1,000 individuals. There is one Nevada record of this species occupying a building near Searchlight for a period in January (Hatfield, 1937) when ambient temperature was 29° Celsius.

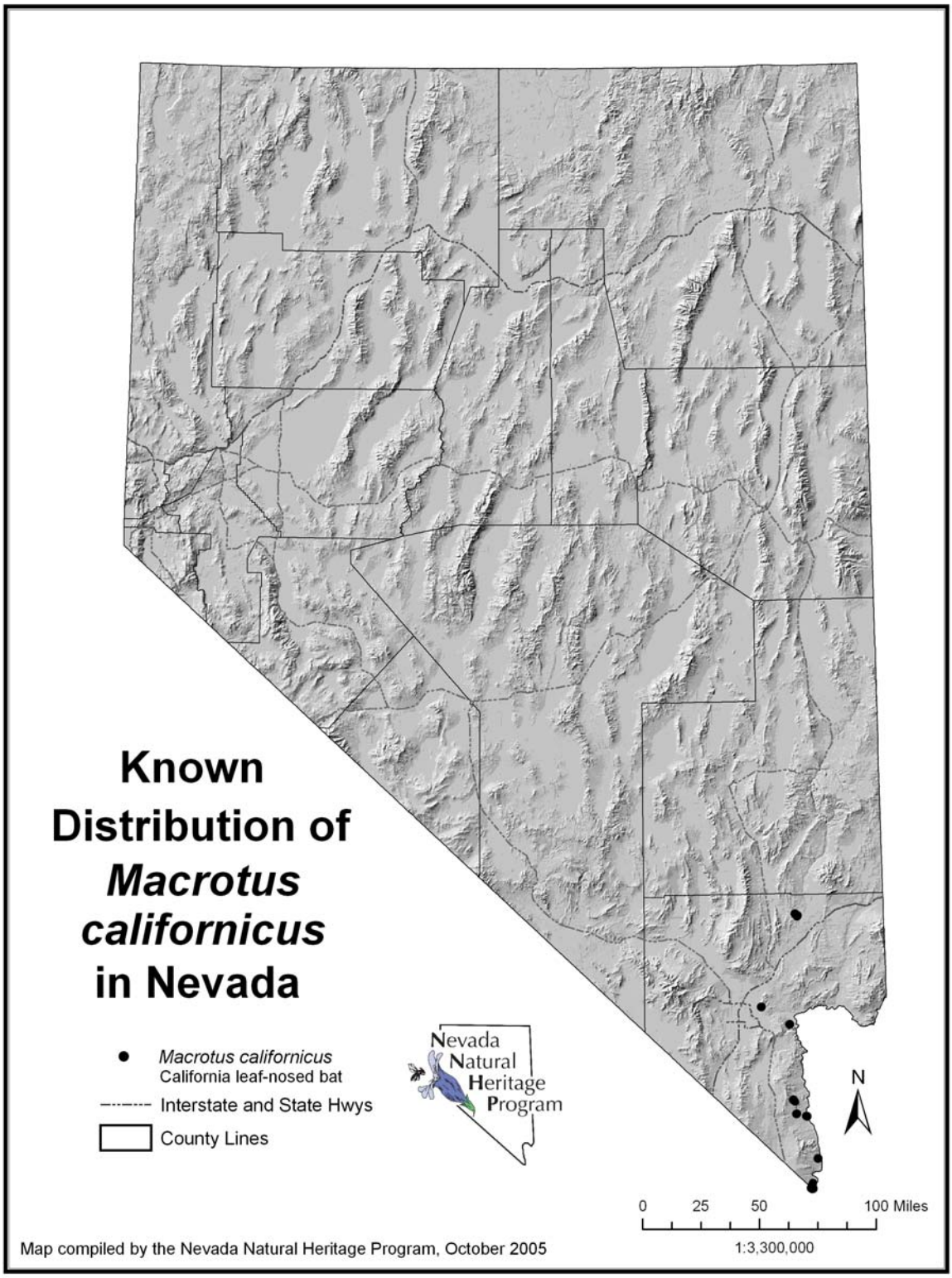
Reproduction: One young per year with birth occurring from mid-May to early July, depending on annual variations in weather conditions. Females congregate in maternity roosts of 6 to > 100, frequently spatially clustered. Each of these clusters may be associated with a male, although separate, entirely male colonies also form. In the fall, males congregate at lek courtship sites in mines. Mating and fertilization occurs in the fall with delayed development of the embryo until spring.

Food Habits: Food items include grasshoppers, cicadas, moths, butterflies, dragonflies, beetles, and caterpillars. Foraging occurs close to vegetation or the ground and prey items are gleaned from these surfaces. Does not require drinking water, but gets moisture from prey items.

Current Nevada Status: State protected as Sensitive. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. USFS: Region 5 Sensitive. NNHP: G4S2.

Conservation/Management Issues: Recreational caving; mine reclamation; renewed mining; water impoundments; availability of desert wash riparian vegetation. Behaviorally sensitive to roost disturbance. Populations in adjoining States are declining.

Relevant References: Anderson (1969), Bell (1985), Bell et al. (1986), Brown (1993, 1994, 2005), Brown and Berry (2004), Brown et al. (1993), Burt (1934), Hall (1946), Hatfield (1937), Lu and Bleier (1981), O'Farrell (1970), Vaughan (1959), Williams (2001).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Map compiled by the Nevada Natural Heritage Program, October 2005

Vespertilionidae

***Antrozous pallidus* — pallid bat**

Distribution: Found throughout the state, primarily in the low and middle elevations (1,800 m), although has been found at over 3,100 m.

Habitat Characteristics: Found in a variety of habitats from low desert to brushy terrain to coniferous forest and non-coniferous woodlands. Current Nevada records indicate this species is distributed between 420-2,580 m (mean = 1,426 m $\pm$ 431 m) in pinyon-juniper, blackbrush, creosote, sagebrush, and salt desert scrub habitats.

Resident Status: Year round resident.

Winter Status: Hibernates but periodically arouses to actively forage and drink in the winter.

Roost Sites: Selects a variety of day roosts including rock outcrops, mines (maternity colonies have been found in geothermally-influenced adits), caves, hollow trees, buildings, and bridges. Night roosts very commonly under bridges, but also caves and mines. Intolerant of roosts in excess of 40°C.

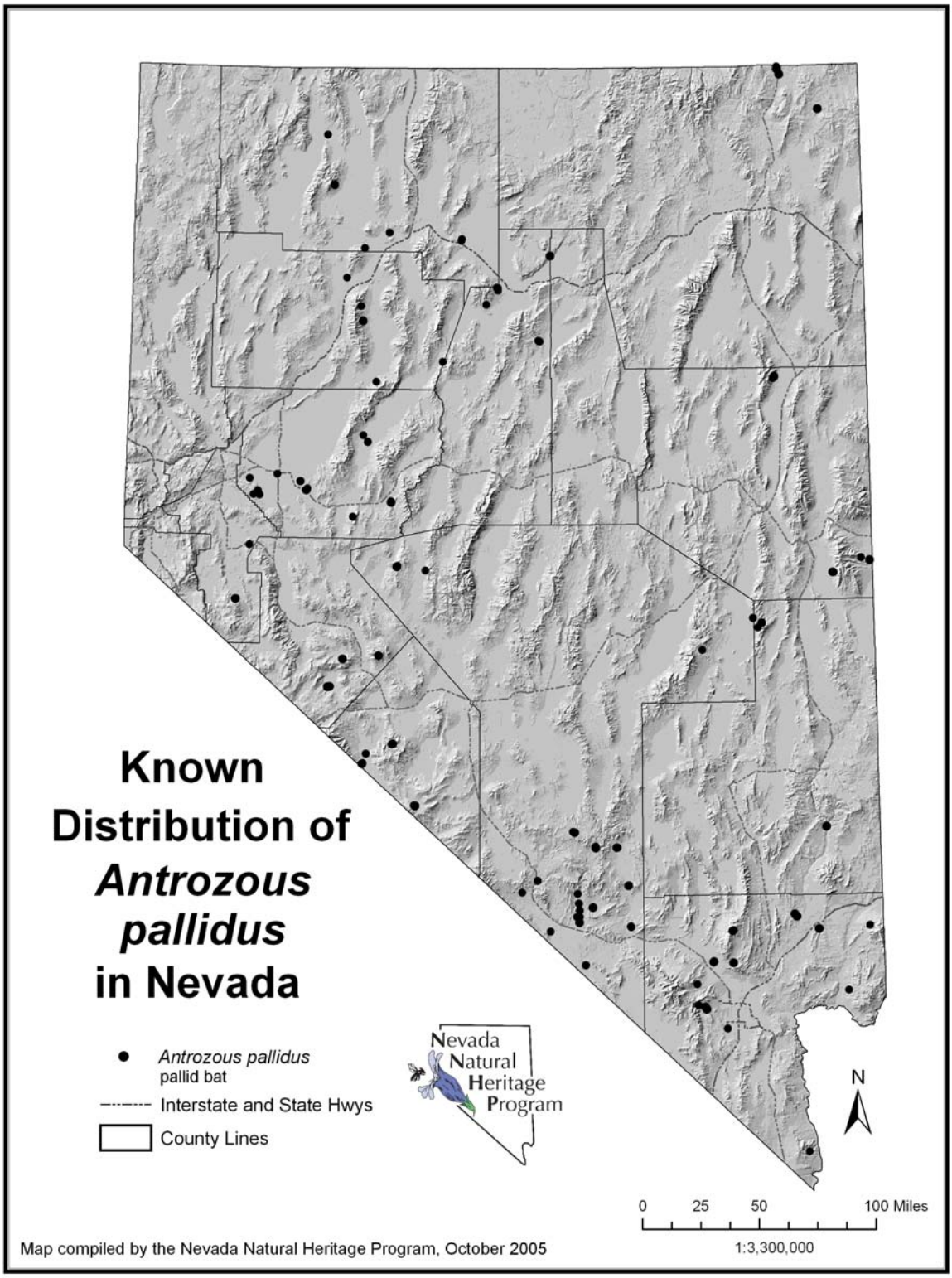
Reproduction: One to two young per year, with birth occurring in May to June. Nursery colonies may contain up to several hundred females, but generally less than 100 individuals.

Food Habits: Food items are primarily large ground-dwelling arthropods (scorpions, centipedes, millipedes, grasshoppers, long-horned beetles, Jerusalem crickets), but also include large moths. Foraging occurs in and among vegetation as well on the ground surface. Pallid bats may actually land and take prey.

Current Nevada Status: State Protected. BLM: Sensitive. USFS: Inyo NF Sensitive. NNHP: G5S3.

Conservation/Management Issues: Recreational caving; closure of mines for reclamation; renewed mining; and water impoundments. Behaviorally sensitive to roost disturbance. Need more information on seasonal movements and winter activity patterns.

Relevant References: Brown (1976), Hall (1946), Hermanson and O'Shea (1983), Lewis (1993, 1994, 1996), Licht and Leitner (1967), O'Farrell and Bradley (1977), Orr (1954), Pierson et al. (1996), Rambaldini (2005), Ruffner et al. (1979), Williams (2001).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Map compiled by the Nevada Natural Heritage Program, October 2005

Corynorhinus townsendii — Townsend's big-eared bat

Distribution: Found throughout the state, from low desert to high mountain habitats. Observed foraging in krumholz bristlecone pine as high as 3,500 m in the Snake Range of eastern White Pine County. Distribution is strongly correlated with the availability of caves and abandoned mines..

Habitat Characteristics: Highly associated with caves and mines. Found primarily in rural settings from deserts to lower, mid to high-elevation mixed coniferous-deciduous forest. Current Nevada records indicate this species is distributed between 210-3,500 m (mean = 1,720 m ± 421 m) primarily in pinyon-juniper-mahogany, white fir, blackbrush, sagebrush, salt desert scrub, agricultural, and occasionally in urban habitats.

Resident Status: Year round resident.

Winter Status: Hibernates in mixed sex aggregations of a few to many hundred. Periodically arouses to move to alternate roosts and to actively forage and drink in the winter. Hibernation prolonged in colder areas, and intermittent where climate is predominantly non-freezing.

Roost Sites: A cavern-dwelling species that uses mines, caves, trees and buildings. One of the species most dependent on mines and caves. Trees and buildings must offer "cave-like" spaces in order to be suitable. Will night roost in more open settings, including under bridges. Colony size is typically 35-150, with a few larger (> 200) colonies known. Recent studies indicate that use of roosts is variable within seasons and among years, and multiple surveys may be required before use can be documented.

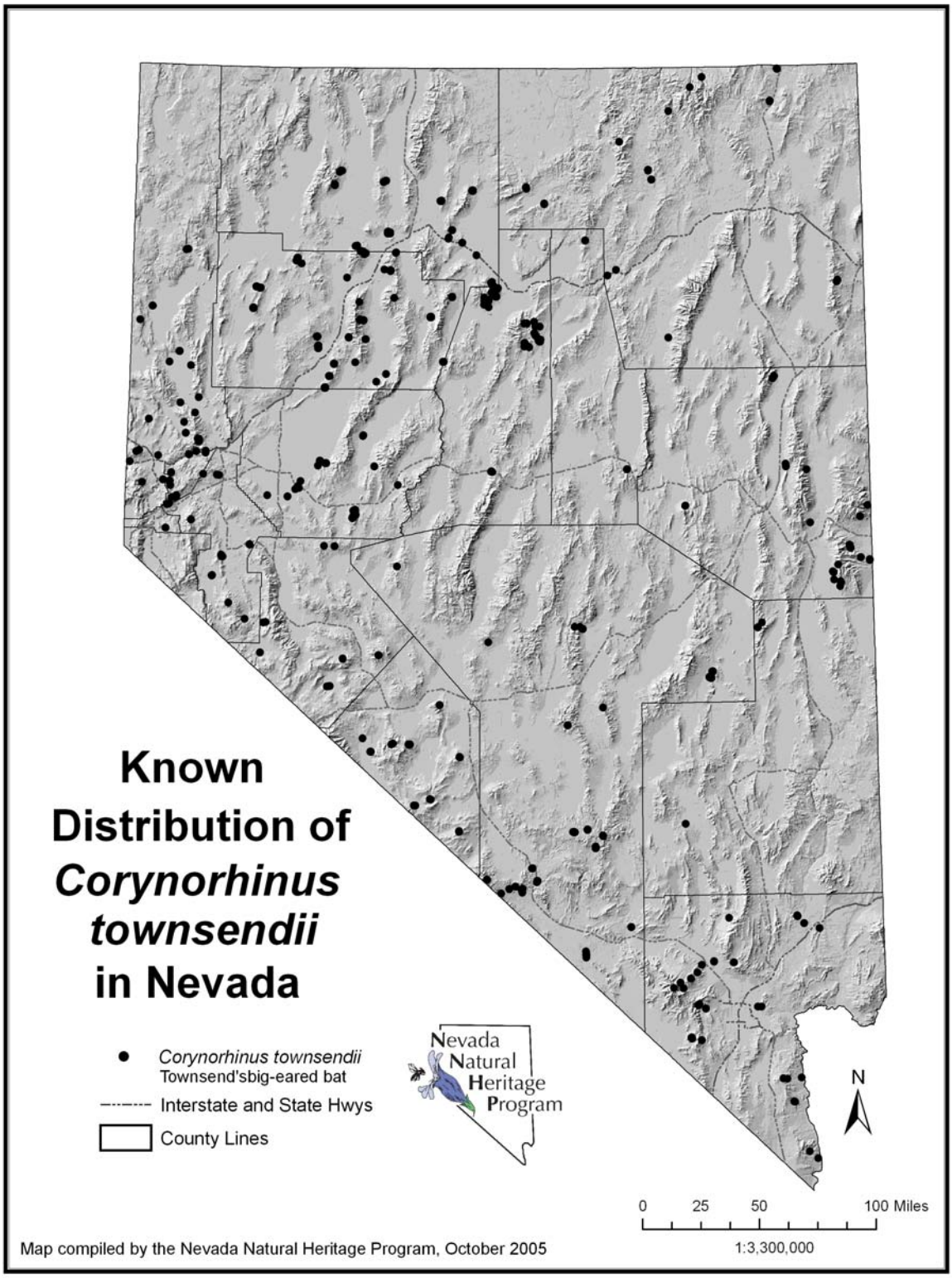
Reproduction: One young per year with birth occurring in May to July, depending on latitude and local climate. Females form maternity colonies; males roost individually. Historically, maternity colonies typically contained several hundred females.

Food Habits: This species is a moth specialist. Foraging occurs near vegetation and other surfaces and prey is probably gleaned from these surfaces. Telemetry studies in northern Nevada have revealed over 95% of foraging activity to be concentrated in open forest habitats of pinyon, juniper, mahogany, white fir, aspen and cottonwood (Bradley, 2000a). This species may travel large distances to suitable foraging areas.

Current Nevada Status: State protected as Sensitive. Serious population declines in past forty years in parts of the western United States (Pierson and Rainey, 1996). Roost size reductions have been documented in Nevada (P. V. Bradley, personal communication). Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. USFS: Sensitive. NNHP: G4S2.

Conservation/Management Issues: Primary threats consist of disturbance and destruction of roost sites. Its habit of roosting on open surfaces makes it readily detectable and therefore highly susceptible to disturbance at roost sites. Recreational caving; closure of mines for reclamation; renewed mining; frequent, repeated surveys during hibernation and maternity seasons; water impoundments; loss of building roosts; and bridge replacement. Location, protection, and monitoring of significant roosts are needed as well as more information on foraging requirements and seasonal movement patterns.

Relevant References: Bradley (2000a), Brown et al. (1994), Graham (1966), Hall (1946), Humphrey and Kunz (1976), Fellers and Pierson (2002), Kunz and Martin (1982), Mohr (1972), Pearson et al. (1952), Perkins (1990), Piaggio (2005), Piaggio and Perkins (in review), Pierson and Fellers (1994), Pierson and Rainey (1996), Pierson et al. (1991), Pierson et al. (1999), Sherwin and Strickland (2000), Sherwin et al. (2000b, 2003), Stebbings (1966), Stihler and Hall (1993), Wackenhut (1990), Western Association of Fish and Wildlife Agencies (2002).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Map compiled by the Nevada Natural Heritage Program, October 2005

Eptesicus fuscus — big brown bat

Distribution: Found throughout the state, from low to high elevations (220 to > 3,000 m).

Habitat Characteristics: Occurs in a variety of habitats, including pinyon-juniper, blackbrush, creosote, sagebrush, agriculture, and urban habitats. Better adapted to human habitation than most species. Current Nevada records indicate this species is distributed between 300-3,000 m (mean = 1,723 m ± 573 m).

Resident Status: Year round resident.

Winter Status: Hibernates but periodically arouses to actively forage and drink in the winter. Year-round resident. Characteristics and locations of winter hibernacula in Nevada are completely unknown, and poorly understood throughout this species range.

Roost Sites: Selects a variety of day roosts including caves, trees (e.g., Ponderosa pine, quaking aspen and oaks), mines, buildings and bridges. Often night roosts in more open settings in buildings, mines and bridges. Roosts in groups up to several hundred.

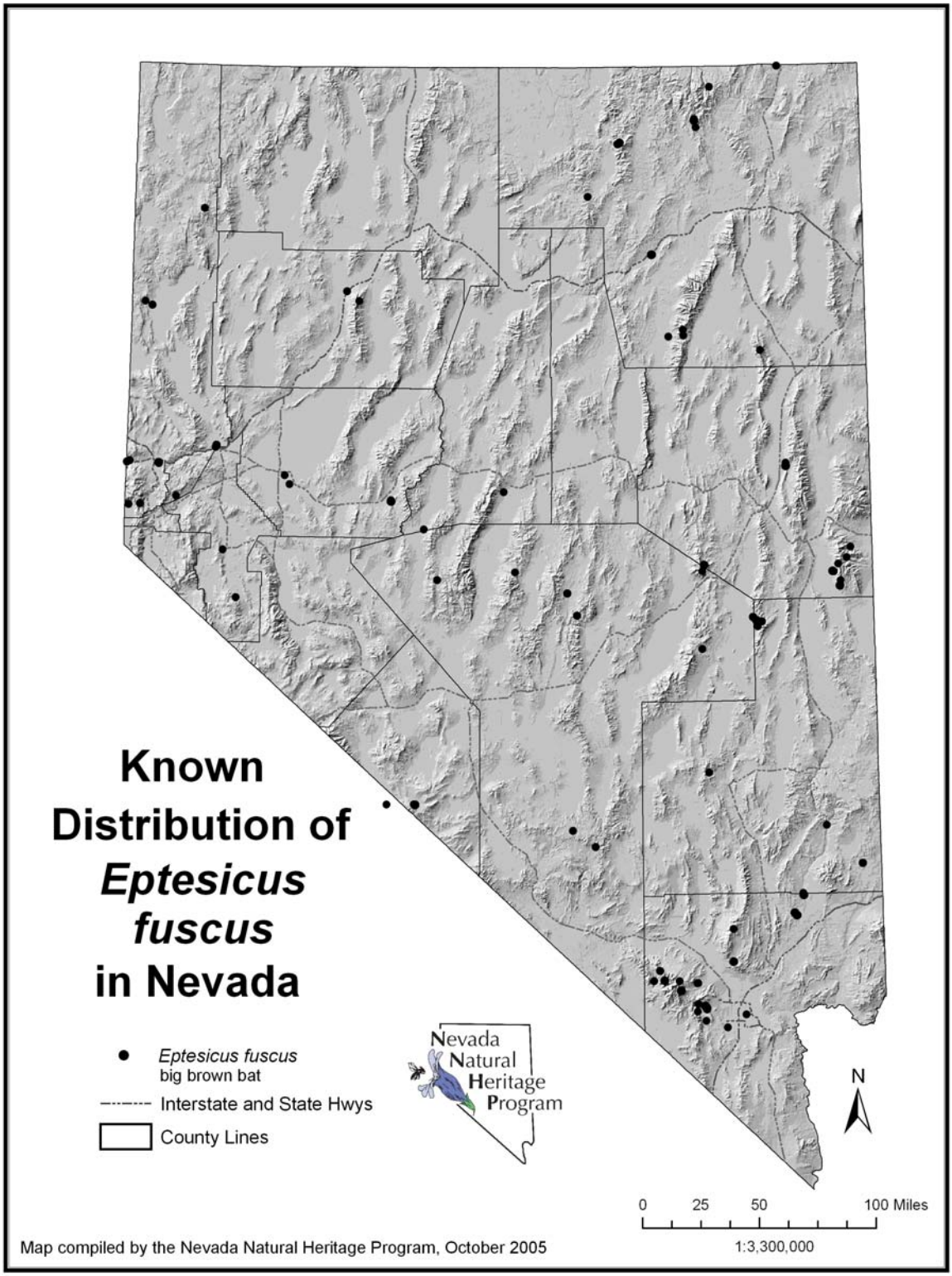
Reproduction: One young per year (twins in portions of its eastern range) with birth occurring in May to June. Females form relatively small maternity colonies (20-200).

Food Habits: Feed on a wide range of insect taxa, but beetles and caddis flies are dominant in the diet. Foraging occurs in the open over land and water, as well as in both forested and edge situations.

Current Nevada Status: State unprotected. Widespread and regionally common. BLM: Sensitive. NNHP: G5S4.

Conservation/Management Issues: Roost disturbance and destruction; Timber harvest; bridge replacement; building demolition; recreational caving; mine reclamation; renewed mining; water impoundments; pest control exclusion. Need more information about roosting requirements (particularly in forests), seasonal movement patterns, and hibernation sites (locations and microhabitat characteristics).

Relevant References: Betts (1996), Black (1976), Borrell and Ellis (1934), Brigham (1991), Brigham and Fenton (1986), Hall (1946), Kurta and Baker (1990), Menzel et al. (2001), O'Farrell and Bradley (1977), Perkins (2005), Vonhof (1996), Whitaker et al. (1997), Williams (2001).


Known Distribution of *Eptesicus fuscus* in Nevada
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Map compiled by the Nevada Natural Heritage Program, October 2005

Euderma maculatum — spotted bat

Distribution: Known from only twelve localities, but scattered distribution throughout Nevada. Distribution is patchy and linked to availability of cliff roosting-habitat. Recent studies have documented significant activity throughout the summer months in the Muddy River drainage (Williams, 2001). There are recent high elevation records from the Sierra Nevada in California (P. E. Brown, personal communication) and lower elevation basalt canyon records just across the border in southern Idaho. The Idaho portion of the Bruneau-Jarbidge River area appears to be an important population center (Doering and Keller, 1998). Detected acoustically in Lincoln County in 2003 (Tomlinson and Kenney, 2005)

Habitat Characteristics: Found in a wide variety of habitats from low elevation desert scrub to high elevation coniferous forest habitats, including pinyon-juniper, sagebrush, riparian and on urban high-rise (cliff analog) habitats. Closely associated with rocky cliffs. Current Nevada records indicate this species is distributed between 540-2,130 m (mean = 1,447 m $\pm$ 569m).

Resident Status: Year round resident.

Winter Status: Hibernates but periodically arouses to actively forage and drink in the winter. Characteristics and locations of winter hibernacula in Nevada are completely unknown, and poorly understood throughout this species range.

Roost Sites: Day roosts primarily in crevices in cliff faces but some indication that mines and caves may occasionally be used, primarily in winter. Has been found roosting on/in buildings but reliance on such roosts is unclear. Likely roosts singly.

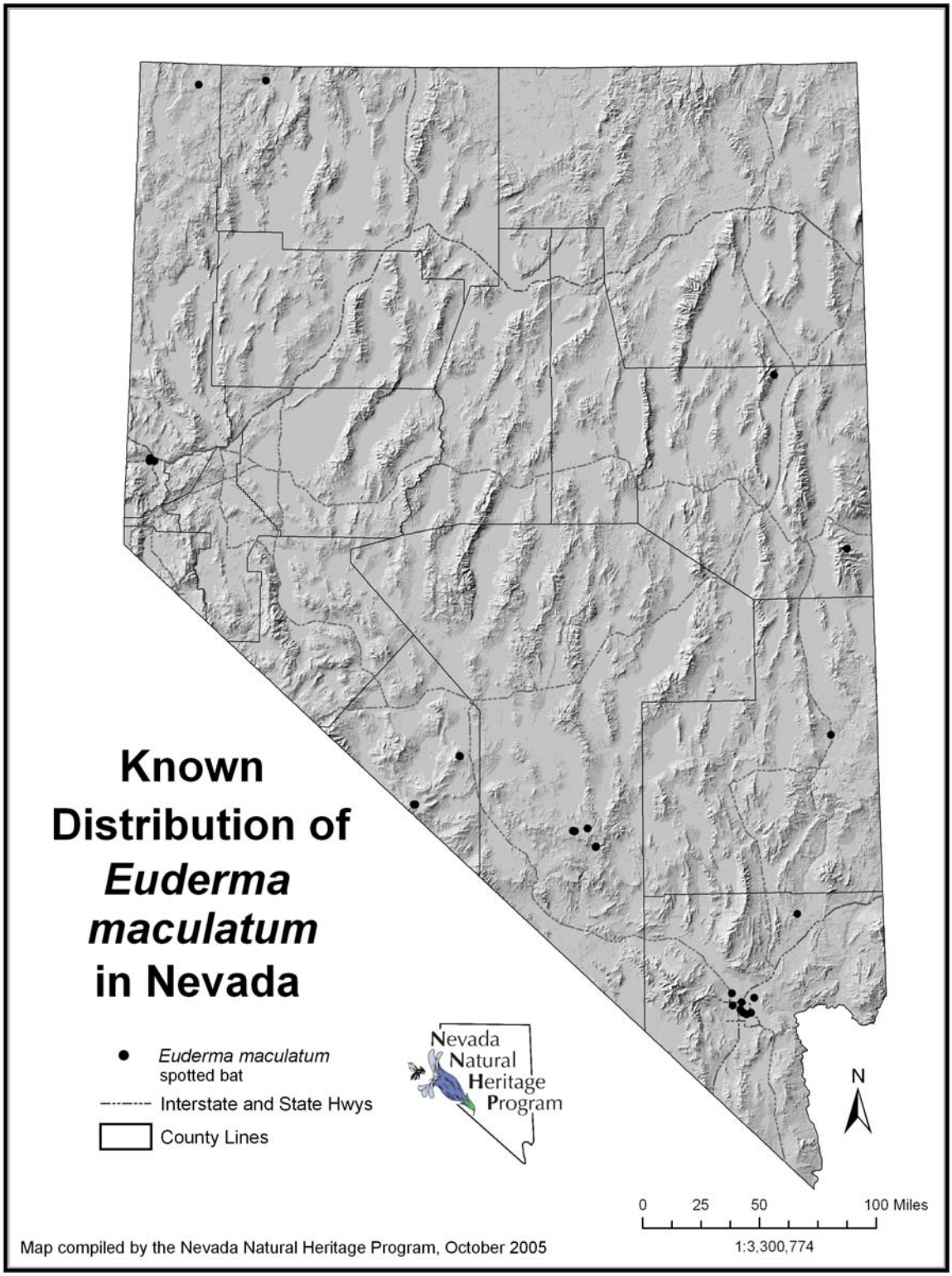
Reproduction: One young per year with birth occurring in June to July.

Food Habits: Diet includes a variety of insects but predominantly consists of moths. In desert settings, foraging occurs in canyons, in the open, or over riparian vegetation. In montane habitats, individuals forage over meadows, along forest edges, or in open coniferous woodland. Animals generally forage alone, apparently maintaining foraging territories, and at other times “trap lining”. This species is capable of flying long distances to suitable foraging grounds.

Current Nevada Status: State Protected: Threatened. Rare and patchy in occurrence although recent findings indicate it may be more common than previously thought. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Special Status Species. USFS: Sensitive. NNHP: G4S2.

Conservation/Management Issues: Recreational climbing; water impoundments; grazing/meadow management; mining and quarry operations. Need more information on distribution, status, breeding range, and life history. Winter habits are not well known and hibernacula microclimates not documented.

Relevant References: Constantine (1987), Chambers and Herder (2005), Deacon and Bradley (1962), Doering and Keller (1998), Fenton et al. (1987), Geluso (2000), Hall (1946), Kuenzi et al. (1999), Leonard and Fenton (1983), Luce and Keinath (2005), Navo et al. (1992), Perry et al. (1997), Pierson and Rainey (1995), Poché (1981), Poché and Bailie (1974), Rabe et al. (1998a), Storz (1995), Szewczak et al. (1998), Wai-ping and Fenton (1989), Watkins (1977), Williams (2001), Woodsworth et al. (1981).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Map compiled by the Nevada Natural Heritage Program, October 2005

Idionycteris phyllotis — Allen's big-eared bat

Distribution: Found in southern Nevada. Records limited to Clark County, primarily in the Spring Mountains. May be in southern Lincoln and Nye counties as well.

Habitat Characteristics: In the summer, generally occupies high elevation pine and oak woodland but also uses a variety of riparian woodland across a wide elevational gradient. In the winter, generally found at lower elevations from creosote bush to pinyon-juniper habitats. In Arizona, a summer roost is located in creosote bush scrub with individuals foraging in Pinyon-Juniper habitat (P. E. Brown, personal communication). Current Nevada records indicate this species is distributed between 510-1,830 m (mean = 1,192 m $\pm$ 440 m).

Resident Status: Probably year round resident, but shifts elevations from summer to winter.
Winter Status: Hibernates but periodically arouses to actively forage and drink in the winter.

Roost Sites: Generally prefers to day roosts in trees (large dead snags) but mines and caves are also used. There is a known mine roost in Arizona.

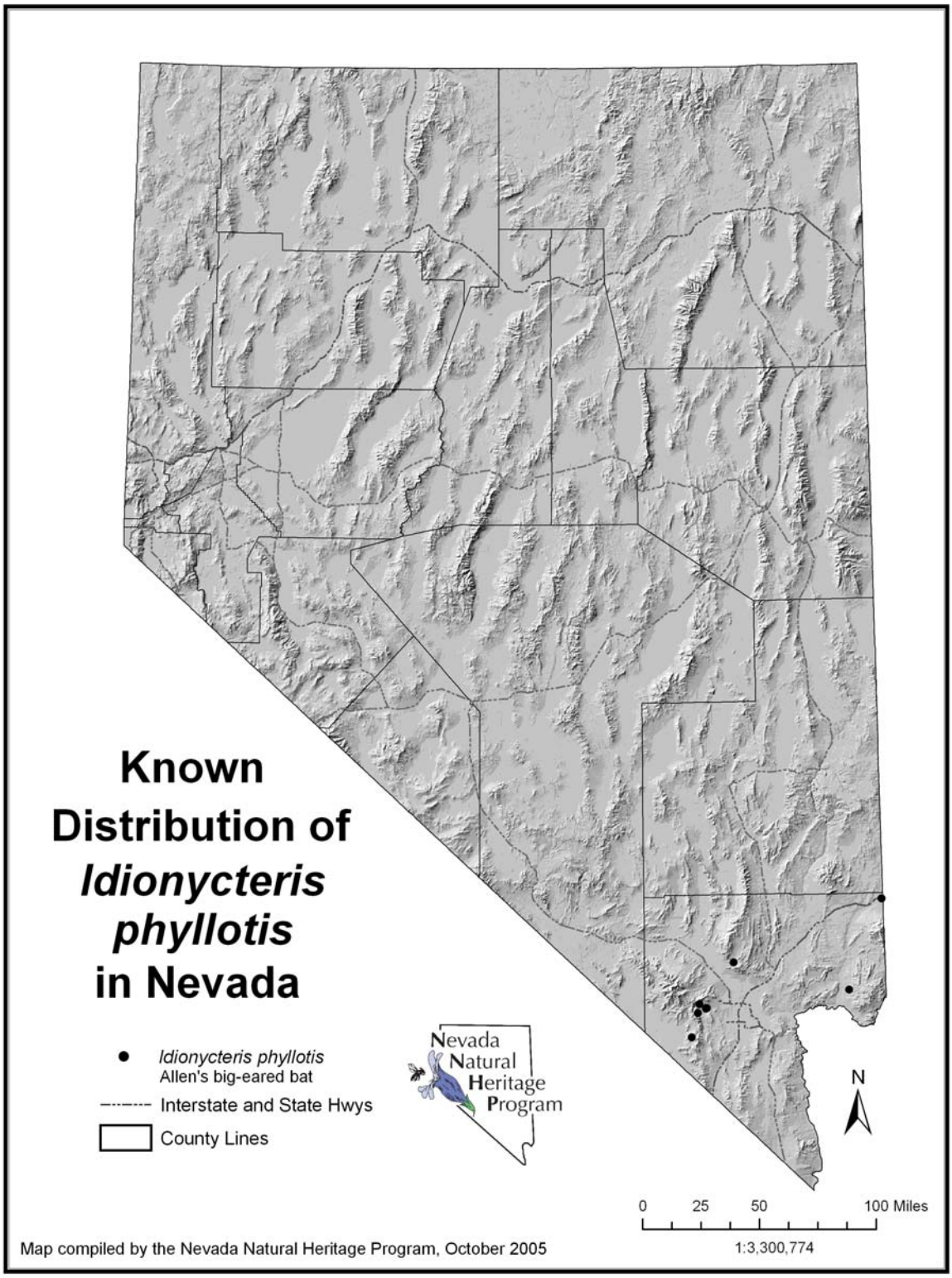
Reproduction: One young per year with birth occurring in June to July.

Food Habits: Food items include a variety of insects but predominantly consists of moths. May be a specialist targeting "hearing" moths. Is capable of traveling large distances to suitable foraging ground.

Current Nevada Status: State unprotected. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G3G4S1.

Conservation/Management Issues: Roost disturbance and destruction; Mine and quarry operations; mine reclamation; renewed mining; water impoundments; grazing/meadow management; timber management, particularly snag management. Little is known about maternity and winter roost requirements. Foraging behavior, reproductive biology and population dynamics are poorly understood.

Relevant References: Brown and Berry (2001, 2004), Brown and Lewis (2005), Cockrum and Musgrove (1964), Czaplewski (1983), Hoffmeister (1986), O'Farrell (2002a), O'Farrell and Bradley (1969), Rabe et al. (1998b), Simmons and O'Farrell (1977).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Lasionycteris noctivagans — silver-haired bat

Distribution: Widely distributed in the state, but confined primarily to forested habitats. Found in riparian habitats in the south and in woodland and riparian habitats in the central and northern portions of the state.

Habitat Characteristics: A forest-associated species, more common in mature forests. Found primarily at higher latitudes and altitudes. Found in coniferous and mixed deciduous/coniferous forests of pinyon-juniper, subalpine fir, white fir, limber pine, aspen, cottonwood and willow. Usually found at lower elevations in southern Nevada associated with riparian corridors. Current Nevada records indicate this species is distributed between 480-2,520 m (mean = 1,679 m $\pm$ 525 m).

Resident Status: Poorly understood. Recent August records of seven post-lactating females and four juveniles in mixed subalpine fir/limber pine/aspen habitat (Bradley, 2000b) and four lactating females in mixed coniferous/deciduous forest (Bradley, 2004) indicates maternity activity in northeast Nevada.

Winter Status: Migrates but probably hibernates in some parts of its winter range. Migratory patterns not well understood. Recent October records of migrating individuals, one juvenile near Mesquite, in the foothills of the Virgin Mountains (M. J. O'Farrell, personal communication) and one in the Santa Rosa Mountains of Humboldt County (P. V. Bradley, personal communication). In Spring Valley of Eastern Nevada, one individual was observed flying and drinking during mid-day in January 2002 (J. A. Williams, personal communication).

Roost Sites: Roosts almost exclusively in trees in summer. Maternity roosts are generally in woodpecker hollows and under the loose bark of large diameter snags. They are generally located at least 15m above ground. Uses multiple roost sites, switching them frequently. Small groups and single animals will roost under exfoliating bark. Winter roosts include hollow trees, rock crevices, mines, caves, and houses. Also has been found roosting under leaf litter.

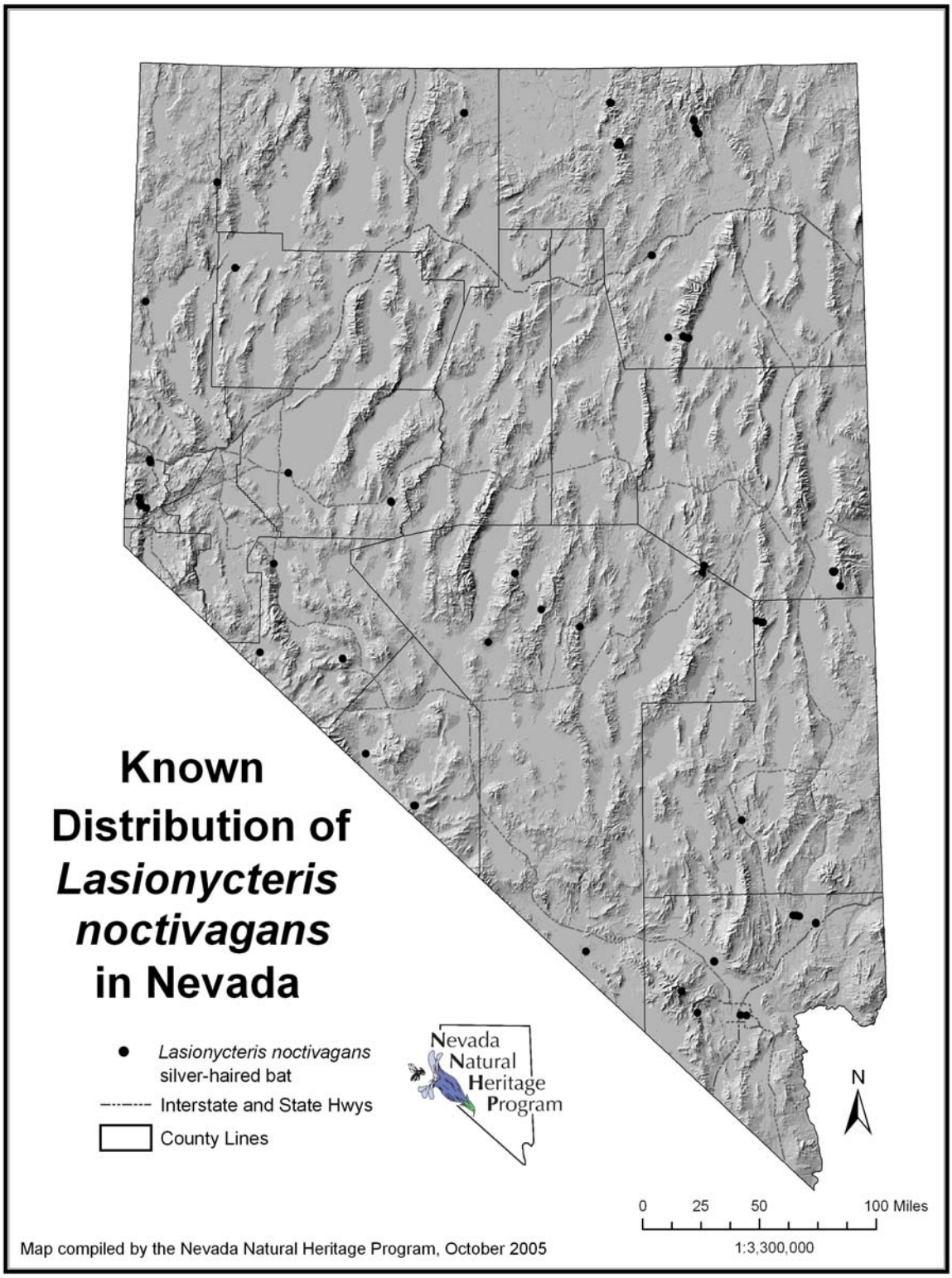
Reproduction: One to two young per year but generally two, with birth occurring in June to July. Forms small maternity colonies of several to about 75 individuals.

Food Habits: Diet consists of a variety of insects but moths feature prominently. Foraging is generally above the canopy layer in or near wooded areas and along edges of roads, streams or water bodies. Travels considerable distances (up to 15 km) from roost sites to foraging areas.

Current Nevada Status: State unprotected. Locally common, at least seasonally. BLM: Sensitive. NNHP: G5S3.

Conservation/Management Issues: Timber harvest; grazing of riparian habitats; pesticide spraying. Need more information about breeding populations, roost requirements, and the timing and patterns of migration.

Relevant References: Barclay (1985), Barclay et al. (1988), Betts (1996), Bradley (2000b, 2004), Bradley et al. (1965), Burt (1934), Campbell (1996), Campbell et al. (1996), Hall (1946), Izor (1979), Jung et al. (1999), Krutzsch (1966), Kunz (1982), Kurta and Stewart (1990), Mattson et al. (1996), Parsons et al. (1986), Perkins (2005), Perkins and Cross (1988), Sanborn (1953), Vonhof (1996), Williams (2001).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Map compiled by the Nevada Natural Heritage Program, October 2005

Lasiurus blossevillii — western red bat

Distribution: Historically known from only two locations, one of which (Fallon area) yielded additional specimens in 1958 (R. Alcorn Collection, Nevada State Museum, Las Vegas). A third location near Dyer was documented in September 1999 (P. E. Brown, personal communication). Recent acoustic sampling in the Muddy River drainage in Clark County have yielded records of occurrence in late spring and early summer 2000, and three females and two males were captured between July and September in the same drainage (Williams, 2001). It has also been detected acoustically in the northern portion of the Nevada Test Site during the summers of 1999 and 2000 (Bechtel Nevada, 2001). Two acoustic records were obtained near the Truckee River west of Fernley (O'Farrell, 2001a and b). Acoustic records from two localities in Lincoln County were documented in 2003 (Tomlinson and Kenney, 2005)

Habitat Characteristics: Found primarily in wooded habitats, including mesquite bosque and cottonwood/willow riparian areas. Current Nevada records indicate this species is distributed between 420-2,010 m (mean = 1,200 m $\pm$ 602 m).

Resident Status: Thought to be a migrant but may be a summer resident in the Fallon and Muddy River areas.

Winter Status: Winter behavior poorly understood. Thought to be migratory in NV, although migratory patterns are not well documented. This species is reported to be highly migratory throughout most of its range.

Roost Sites: A solitary rooster; Day roosts in trees, within the foliage and presumably in leaf litter on the ground. A close relative (*Lasiurus borealis*) has been documented roosting in deciduous and coniferous leaf litter on the ground (Moorman et al., 1999; Saugey et al., 1998).

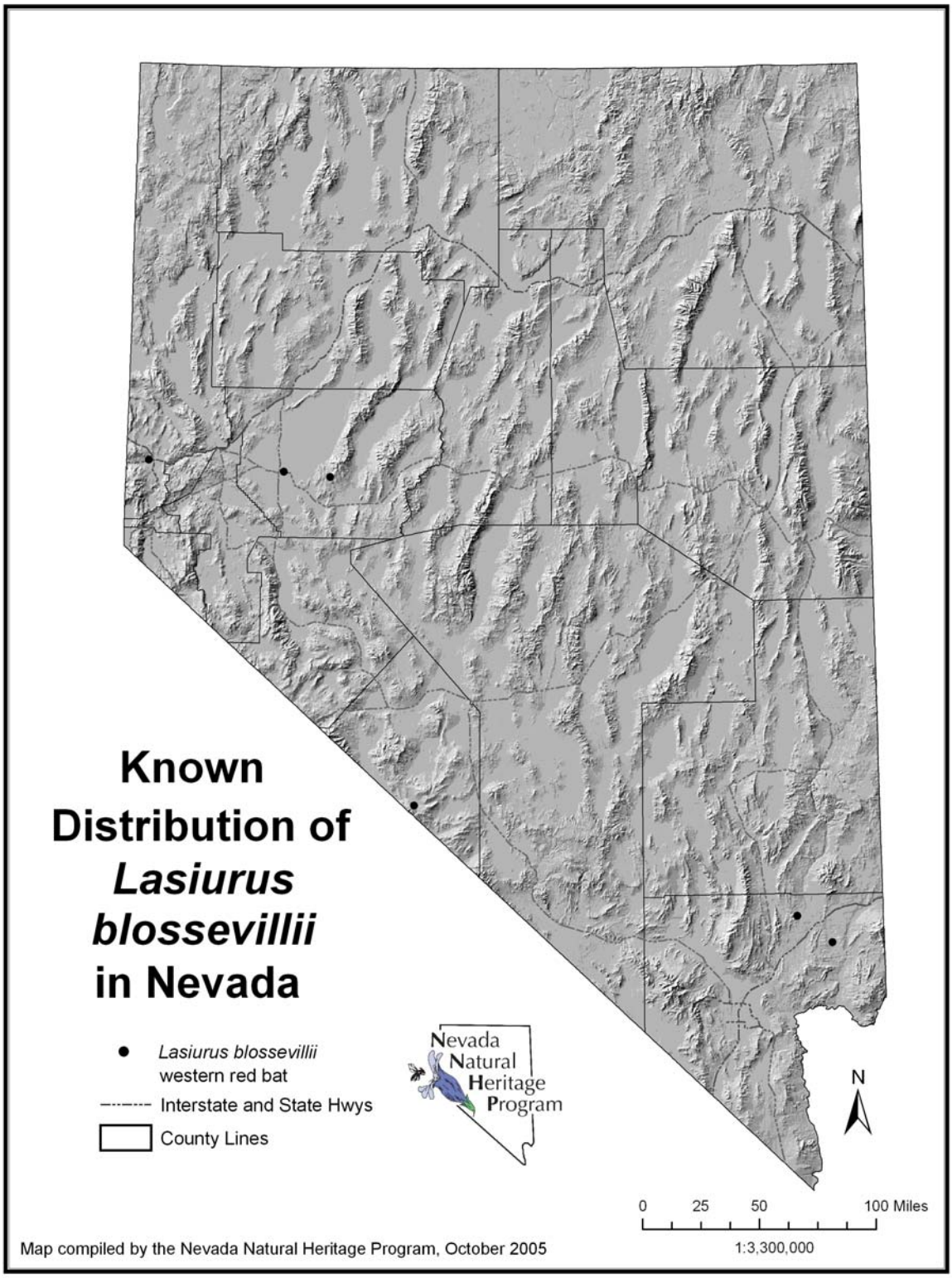
Reproduction: One to five young per year, with an average of 2.3, with birth occurring in June. Individuals roost singly. Does not form colonies.

Food Habits: Food items consist of a wide variety of insects, taken opportunistically apparently based on size rather than type. Foraging is generally high altitude over the tree canopy.

Current Nevada Status: State unprotected. Extremely rare in Nevada. BLM: Sensitive. NNHP: G5S1.

Conservation/Management Issues: Loss and degradation of riparian habitats due to overgrazing agricultural conversion to upland habitat; agricultural spraying; water impoundments; fire; predation, particularly by jays; found by humans and pets in suburban areas. Need more information on seasonal movement patterns, habitat use, roosting locations and characteristics, and status and distribution within the state.

Relevant References: Bolster (2005). Constantine (1959), Hall (1946), Moorman et al. (1999), O'Farrell (2001a, b), Orr (1950a), Saugey et al. (1998), Shump and Shump (1982a), Williams (2001).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Map compiled by the Nevada Natural Heritage Program, October 2005

***Lasiurus cinereus* — hoary bat**

Distribution: Distribution patchy throughout the State and known mostly from the capture of single animals while foraging or acoustic records. Roosting locations are not well known.

Habitat Characteristics: Tree-associated species. Found primarily in forested upland habitats, as well as in gallery-forest riparian zones (e.g., in cottonwoods along the Colorado River drainage), and agriculture habitats. Also found in valley basins in pure stands of Rocky Mountain juniper (*Juniperus scopulorum*) (Bradley and Baldino, 1997). May occur in park and garden settings in urban areas. Current Nevada records indicate this species is distributed between 570-2,520 m (mean = 1,587 m $\pm$ 560 m).

Resident Status: Summer resident. In California, summer residents are primarily males, which may also be the case in much of Nevada although a non-lactating female, along with three reproductively active males were caught over water in August, 1997 at 1,800 m in Spring Valley, east-central Nevada in Rocky Mtn juniper habitat (Bradley and Baldino, 1997). Three females were captured near Yucca Mountain in 1991 (Rakestraw *et al.*, 1998). One was captured on 6 May and one on 14 August over a well pond (990 meters) in Mojave Desert scrub vegetation. Another individual was captured on 13 August in a dry wash. Recent acoustic and capture surveys in the Muddy River and Meadow Valley Wash drainages documented arrival and continued presence from early April through late May (J. A. Williams and M. J. O'Farrell, personal communication). A single capture in late April 2000 was an emaciated adult female. Prolonged presence from March through June was recorded in the upper Moapa Valley (Williams, 2001). Until recently, all records from southern Nevada were from the spring. However, two localities at the Nevada Test Site (Rakestraw et al., 1998; Hall, 2000) and the Spring Mountains (O'Farrell, 2002a) have yielded records in the fall months. Records from the northeast span 15 July to 21 August (Ports and Bradley, 1996). Documented in July at Key Pittman Reservoir and in September in Eagle Valley, Lincoln County (Tomlinson and Kenney, 2005).

Winter Status: Migrates but probably hibernates in parts of its winter range. Records are primarily from the spring and fall but migratory patterns in Nevada are not known.

Roost Sites: Solitary. Day roosts in trees, within foliage 3-12 m above the ground in both coniferous and deciduous trees. Some unusual roosting situations have been reported in caves, beneath a rock ledge, in a woodpecker hole, and in a squirrel's nest.

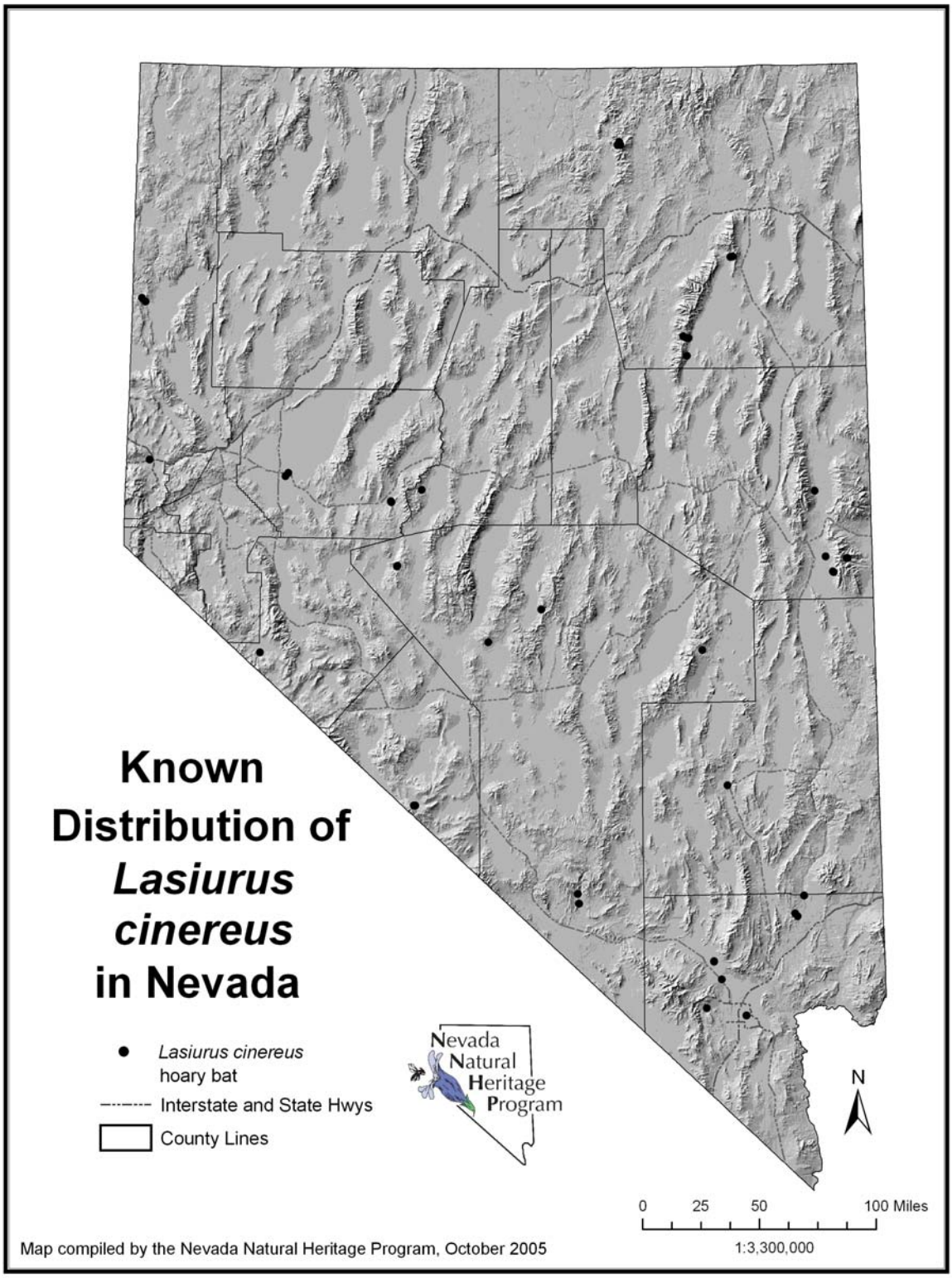
Reproduction: One to four young per year but generally two, with birth occurring in May to June. Maternity colonies are not formed.

Food Habits: Food items include a variety of insects but moths, dragonflies, and beetles feature prominently. Foraging is generally high altitude and occurs over tree canopy. In the open, rapid descending arcs are exhibited. Also, will follow watercourses for foraging and drinking. It forages over long distances, up to 40 km from its roost. Evening emergence is variable, from one hour after sunset to midnight.

Current Nevada Status: State unprotected. Widespread but may be threatened by reduction in forest cover. BLM: Sensitive. NNHP: G5S3.

Conservation/Management Issues: Loss of roosting habitat due to timber harvest; pesticide spraying; loss of riparian habitats. In urban/suburban areas may encounter people and pets (frequently turned in to public health facilities); predation by jays. In areas being developed for wind energy, windmills may pose a significant threat to this species, especially during migration. More information is needed about seasonal movement patterns, and distribution and status within Nevada.

Relevant References: Barclay (1985), Bolster (2005), Bradley and Baldino (1997), Bradley et al. (1965), Constantine (1959), Findley and Jones (1964), Hall (1946), Hall (2000), Hickey (1990), Hickey (1992), Hickey et al. (1996), Jung et al. (1999), O'Farrell (2002a), O'Farrell and Bradley (1977), O'Farrell et al. (2000), Orr (1950b), Perkins and Cross (1988), Ports and Bradley (1996), Rakestraw et al. (1998), Shump and Shump (1982b), Williams (2001).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Lasiurus xanthinus — western yellow bat

Distribution: Formerly referred to as a subspecies of *Lasiurus ega* (southern yellow bat) but recent genetic work indicates specific status. An apparent expansion northward in the species' range in southern California has been documented (Constantine, 1998a; P. E. Brown, personal communication; M. J. O'Farrell, personal communication). The first occurrence of this species in Nevada was in the Muddy River drainage. It was documented by photograph in February 1999 and confirmed by vocal signature and capture in March 2000 (O'Farrell et al., 2004). Distribution is widespread within the upper Moapa Valley (Williams, 2001). Documented regularly at various acoustic monitoring sites in the Las Vegas Wash (M. J. O'Farrell, personal communication). Other areas with concentrations of palms are being systematically examined for presence but no further locations in southern Nevada have been found to date.

Habitat Characteristics: Primarily associated with fan palms oases in Nevada and elsewhere, but also occurs in riparian corridors. The apparent spread of the species appears related to urban use of palms in landscaping. Current Nevada records indicate this species is distributed between 524-549 m.

Resident Status: Apparent year-round resident.

Winter Status: Active individuals have been found within the extensive palm groves at the Moapa National Wildlife Refuge (O'Farrell et al., 2004). Presence has been documented throughout the year (O'Farrell et al., 2004; Williams, 2001).

Roost Sites: Day roosts in the dead leaf skirts of fan palms. An unusual roosting situation was reported in a hackberry and sycamore, suggesting occasional use of trees other than palms. One record of a male roosting in a yucca was reported for Texas (Higginbotham et al., 2000) and individuals have been reported roosting in cottonwoods along the Bill Williams River in Arizona. It is suspected that individuals roost singly, but loose clusters may be formed.

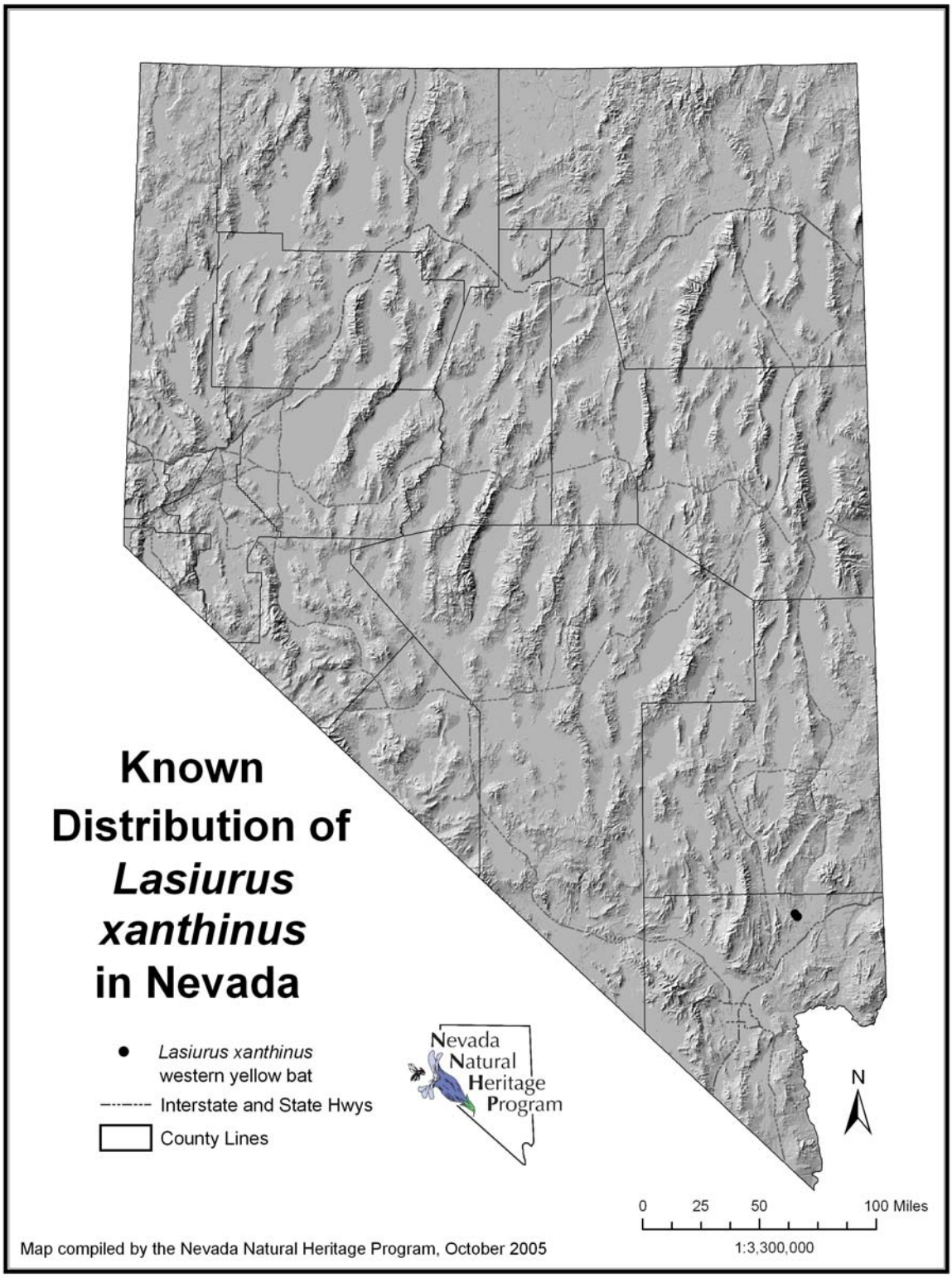
Reproduction: One to four young per year, with pregnancy occurring in April to June. Lactating individuals have been found from June to July.

Food Habits: A variety of insects including *Hymenoptera*, *Diptera*, *Lepidoptera*, and *Coleoptera* were found in the feces of a single specimen (Higginbotham et al., 1999).

Current Nevada Status: State unprotected. Highly localized and restricted to areas with adequate palm roosts. NNHP: G5S1.

Conservation/Management Issues: Trimming of dead leaf skirting, removal of palms, pesticide spraying; loss of riparian habitat. In urban/suburban areas, yellow bats may encounter people and pets (in California it is frequently turned in to public health facilities). More information is needed about Nevada distribution and status.

Relevant References: Baker et al. (1988), Barbour and Davis (1969), Brown (1996), Brown and Berry (2003), Constantine et al. (1979), Constantine (1998a), Higginbotham et al. (1999, 2000), Jones et al. (1999), Kurta and Lehr (1995), Morales and Bickham (1995), Mumford and Zimmerman (1963), O'Farrell et al. (2004), Williams (2001, 2005).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Myotis californicus — California myotis

Distribution: Found throughout Nevada, primarily at the low and middle elevations (to 1,800 m), although occasionally found at higher elevations. More common in the southern half of the state.

Habitat Characteristics: Found in a variety of habitats from Lower Sonoran desert scrub to forests. Current Nevada records indicate this species is distributed between 210-2,730 m (mean = 1,426 m ± 517 m).

Resident Status: Year round resident.

Winter Status: Hibernates but periodically arouses to actively forage and drink in the winter.

Roost Sites: Crevice roosting. Selects a variety of day roosts including mines, caves, buildings, rock crevices, hollow trees, and under exfoliating bark. Night roosts in a wider variety of structures. Generally roost singly or in small groups, although some mines in the Mojave Desert shelter colonies of over 100 in both the summer and winter.

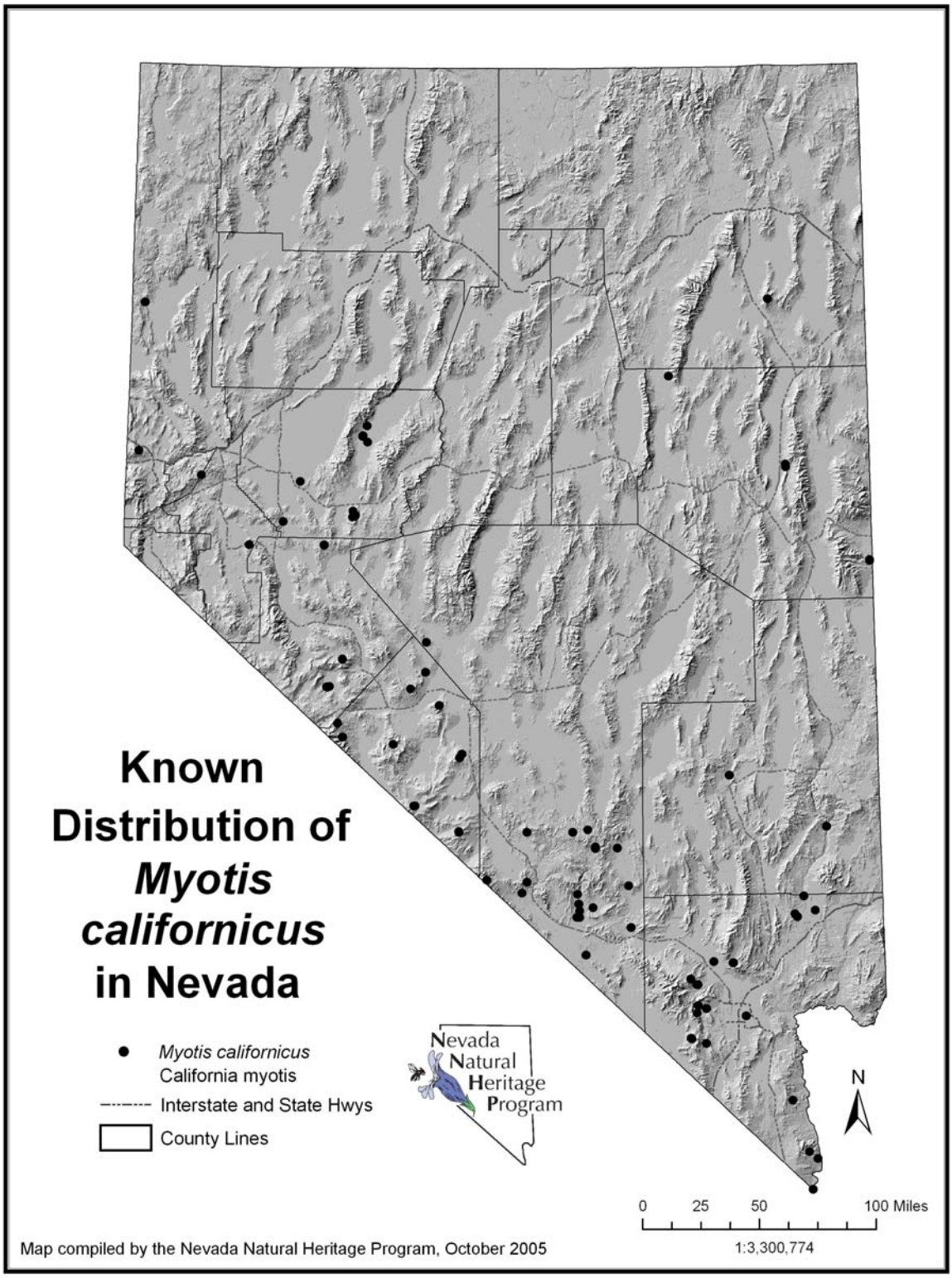
Reproduction: One young per year with birth occurring in May to June. Females may form small maternity colonies, usually less than 100 individuals.

Food Habits: Food items include small moths, flies and beetles. Foraging occurs in the open, but some individuals observed entering mines at dusk presumably to feed on resident insects.

Current Nevada Status: State unprotected. Widespread and regionally common. BLM: Sensitive. NNHP: G5S4.

Conservation/Management Issues: Closure of mines for reclamation; renewed mining; pesticide spraying. Need more information about roosting and foraging requirements, population trends, and acceptance of bat gates. This species looks very similar to *Myotis ciliolabrum* (western small-footed myotis).

Relevant References: Bogan (1974, 1975, in press), Bogan et al. (2005), Brigham et al. (1997), Constantine (1998b), Gannon et al. (2001), Hall (1946), Hoffmeister (1986), Krutzsch (1954), O'Farrell and Bradley (1977), Simpson (1993).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Map compiled by the Nevada Natural Heritage Program, October 2005

***Myotis ciliolabrum* —** western small-footed Myotis

Distribution: Found throughout the state. In the south, primarily found at the middle and higher elevations (> 1,800 m), although occasionally found at lower elevations. In central and northern part of the State it is more common at valley bottoms (1,050-1,800 m).

Habitat Characteristics: Inhabits a variety of habitats including desert scrub, grasslands, sagebrush steppe, and blackbrush, greasewood, pinyon-juniper woodlands, pine-fir forests, agriculture, and urban areas. Current Nevada records indicate this species is distributed between 510-2,760 m (mean = 1,949 m $\pm$ 381 m).

Resident Status: Year round resident.

Winter Status: Hibernates. At least in some areas may tolerate drier and colder hibernacula than some other species. Hibernates individually or in large colonies. A large colony (>100 individuals) was found at a depth of 137 m in an abandoned mine near Eureka (J. S. Altenbach, personal communication).

Roost Sites: Roosts have been found in caves, mines, and trees. Roosting preferences expected to be similar to those for *Myotis californicus*.

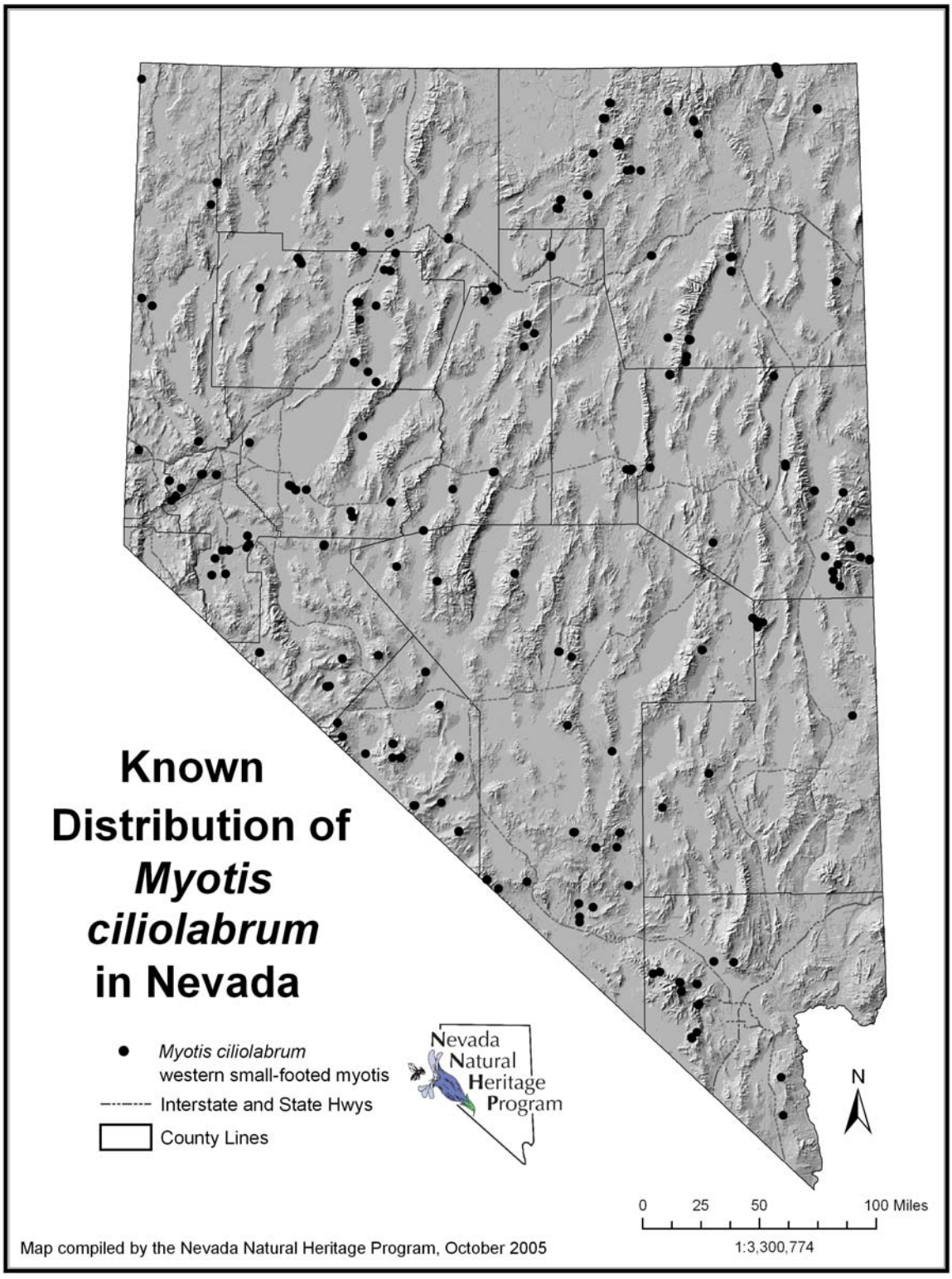
Reproduction: One young per year with birth occurring in May to July. Females may form small maternity colonies, generally fewer than 30 individuals, although one maternity roost in the Mojave Desert had more than 50.

Food Habits: Food items include small moths, flies, ants, and beetles. Foraging occurs in the open.

Current Nevada Status: State unprotected. Widespread and regionally common. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S3.

Conservation/Management Issues: Mine reclamation; renewed mining; recreational caving; water impoundments; timber harvest. Need more information about roosting and foraging requirements, population trends, and acceptance of bat gates. This species looks very similar to *Myotis californicus* (California myotis).

Relevant References: Barbour and Davis (1969), Bogan (1974), Bogan et al. (2005), Constantine (1998b), Gannon et al. (2001), Hall (1946), Ports and Bradley (1996), Hoffmeister (1986), O'Farrell (2001c), Ports and Bradley (1996), Tuttle and Heaney (1974).


Known Distribution of Myotis ciliolabrum in Nevada
Myotis ciliolabrum
western small-footed myotis
Interstate and State Hwys
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Map compiled by the Nevada Natural Heritage Program, October 2005

Myotis evotis — long-eared myotis

Distribution: Found throughout the state, primarily at the higher elevations associated with coniferous forest. More widespread and common in the northern half of the state.

Habitat Characteristics: Primarily a forest-associated species. In southern Nevada, only found in Ponderosa pine or above. Found in pinyon-juniper in the northern portion of Nevada Test Site (D. B. Hall, personal communication). In northern Nevada common in pinyon-juniper and above, but also found in sagebrush and desert scrub habitats. Current Nevada records indicate this species is distributed between 690-3,090 m (mean = 2,072 m $\pm$ 342 m).

Resident Status: Year round resident.

Winter Status: Presumed to be non-migratory and to hibernate locally.

Roost Sites: Day roosts in hollow trees, under exfoliating bark, crevices in small rock outcrops, and occasionally in mines, caves, and buildings. Has been found in rim rock in Oregon, in a road cut in southern California, and in a riprap boulder jumble in northern California. Found roosting in juniper snags in New Mexico. Night roosts have been found in caves, mines, and under bridges. Generally roost singly or in small groups.

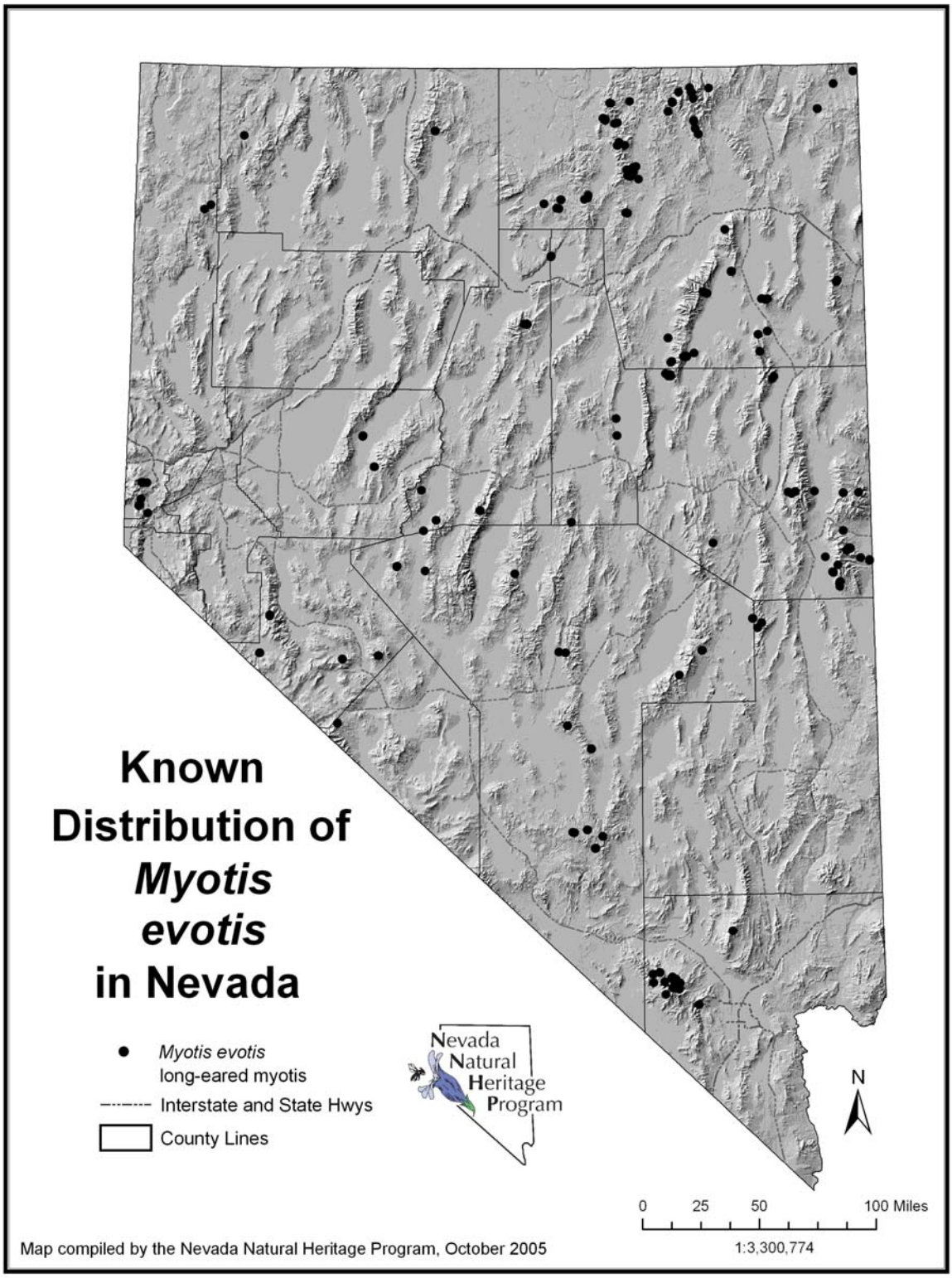
Reproduction: One young per year with birth occurring in June to July. Females may form small maternity colonies with generally less than 40 individuals. A colony of 200 individuals was found in a cave near Sequoia National Park, CA (P. E. Brown, personal communication).

Food Habits: Food items include moths, small beetles, and flies. Foraging occurs near vegetation and the ground. Appears to have a flexible foraging strategy, catching insects by both substrate and aerial pursuit. Forages along rivers and streams, over ponds, and within cluttered forest environment. Night roost use of caves and mines may involve feeding within the structure, gleaning moths from the rock walls.

Current Nevada Status: State unprotected. Widely distributed but uncommon almost everywhere. Status not well understood. May need mature forest in portions of its range. A severe population decline has occurred in the Spring Mountains in southern Nevada (M. J. O'Farrell, personal communication). Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S4.

Conservation/Management Issues: Timber harvest; recreational caving; mine reclamation; renewed mining; water impoundments; highway projects; bridge replacement; building demolition; pest control. More information is needed about population trends, winter roost requirements, winter range, importance of snags, foraging requirements, and use and acceptance of bat gates.

Relevant References: Bogan et al. (2005), Chung-MacCoubrey (1996), Cross (1976), Faure and Barclay (1994), Hall (1946), Manning and Jones (1989), Marcot (1984), Miner et al. (1996), O'Farrell (2002), Ports and Bradley (1996), Vonhof and Barclay (1997).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Map compiled by the Nevada Natural Heritage Program, October 2005
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Myotis lucifugus — little brown bat

Distribution: Found primarily throughout the northern part of the state, but little is known of its distribution and abundance.

Habitat Characteristics: Found primarily at higher elevations and higher latitudes, often associated with coniferous forest. Requires a nearby water source. Occurrence in Dixie Valley, (Churchill County) (1,370 m) has been documented acoustically (P. E. Brown and R. D. Berry, personal communication).

Resident Status: Probably a year round resident.

Winter Status: Hibernates but no hibernating colonies have been found in Nevada. It is suspected that there are elevational movements between summer and winter roosts. No large aggregations of this species, like those known in the eastern U.S. have been found.

Roost Sites: Day roosts in hollow trees, rock outcrops, buildings, and occasionally mines and caves. One of the species most commonly found in human structures. Night roosts may be same structures used for day roost but locations nearest the entrance are preferred. Hibernacula elsewhere are generally mines or caves. Often found in the same roost sites with *Myotis yumanensis*. Large numbers (>100) were occupying bat houses at Ruby Lake NWR Headquarters (Elko County) (1,830 m) as well as buildings (P. E. Brown, personal communication).

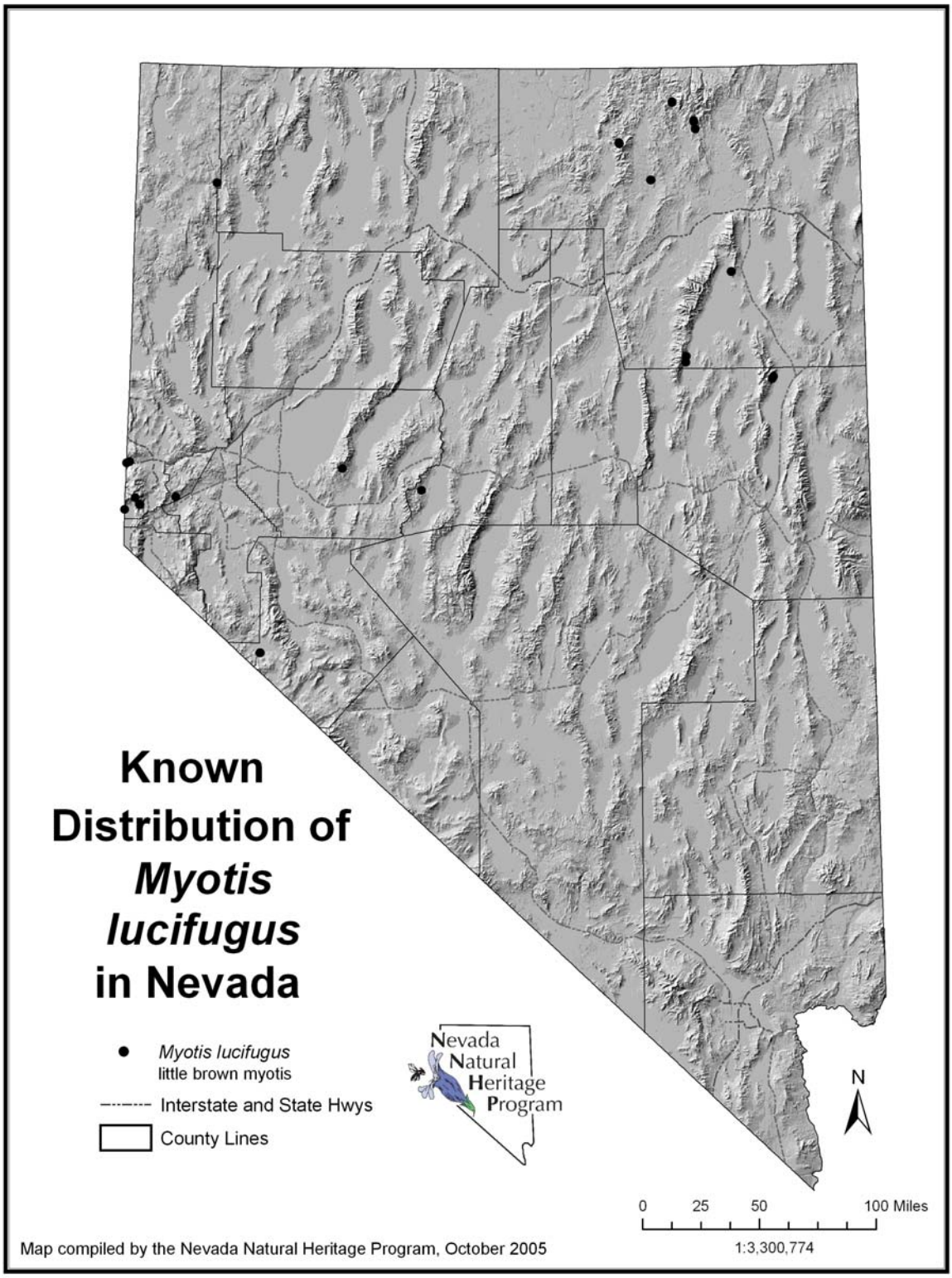
Reproduction: One young per year with birth occurring in May to July. Large maternity roosts (100 to several thousand) of adult females are formed. Males roost singly or in small groups. Hibernating groups contain both sexes.

Food Habits: Feeds heavily on small aquatic insects, such as caddis flies, midges, and mayflies; a variety of other terrestrial insects are also eaten. Foraging occurs in open areas among vegetation, along water margins, and sometimes about 1 m above water surface. When young begin to fly, adults move to more cluttered habitats and leave open foraging areas to the juveniles.

Current Nevada Status: State unprotected. Regionally common and more tolerant of human disturbance than most species. BLM: Sensitive. NNHP: G5S3.

Conservation/Management Issues: Timber harvest; pesticide spraying; building demolition; pest control exclusion; mine reclamation; renewed mining; cyanide ponds. More information needed about location and characteristics of roosting sites, particularly winter hibernacula. This species can be confused with *Myotis yumanensis* (Yuma myotis).

Relevant References: Adams (1990), Borrell and Ellis (1934), Clark et al. (1991), Fenton and Barclay (1980), Hall (1946), Herd and Fenton (1983), Kalcounis (1992), Rainey (2005).


Known
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Map compiled by the Nevada Natural Heritage Program, October 2005

Myotis thysanodes — fringed myotis

Distribution: Found throughout central and southern Nevada. Probably occurs in northern Nevada, as well.

Habitat Characteristics: Found in a wide range of habitats from low desert scrub habitats to high elevation coniferous forests. Found from upper elevation creosote bush desert to pinyon-juniper and white fir (2,150 m) in the White Pine Range (White Pine County). Current Nevada records indicate this species is distributed between 420-2,160 m (mean = 1,590 m $\pm$ 393 m).

Resident Status: Year round resident.

Winter Status: Hibernates but capable of periodic winter activity.

Roost Sites: Day and night roosts in mines, caves, trees, and buildings. The majority of roosts documented in California have been in buildings or mines. Two small nursery roosts have been found in very cool, wet mines in northern California. A maternity colony of approximately 200 individuals was found in a mine in creosote bush scrub in the Mojave Desert (>750 m; P. E. Brown, personal communication). Two maternity colonies have recently been found in mine adits on the Nevada Test Site in blackbrush habitat (D. B. Hall, 2004, personal communication). Has been radio tracked to tree hollows, particularly large conifer snags in Oregon and Arizona, and rock crevices in cliff faces in southern California. Known hibernacula are generally mines or caves.

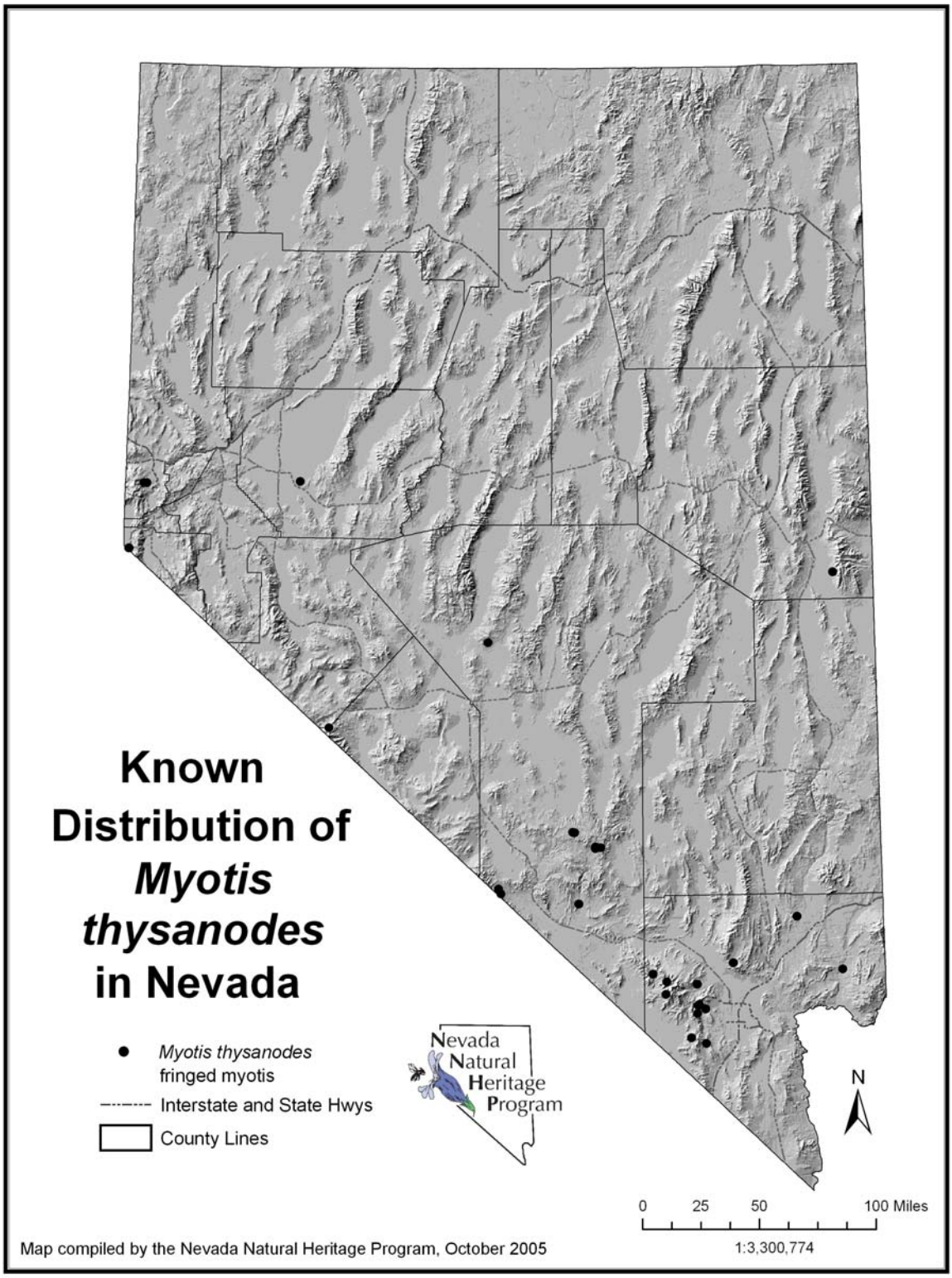
Reproduction: One young per year with birth occurring in May to June. Maternity roosts are comprised of adult females and may include several hundred individuals. Males roost singly or in small groups. Hibernating groups contain both sexes.

Food Habits: Food items vary but there appears to be a selection for small beetles. Foraging occurs in and among vegetation, with some gleaning activity. Diet is primarily beetles, but includes a variety of other taxa including moths. Radiotracking in southern California suggests foraging along forest edges and over the forest canopy. May fly moderate distances (13km, one-way) to suitable foraging areas.

Current Nevada Status: State Protected. Widely distributed but rare in Nevada. Relatively few records but an apparent increase in numbers or area occupied in southern Nevada over the past 20 years. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G4G5S2.

Conservation/Management Issues: Recreational caving; mine reclamation; renewed mining; water impoundments; building demolition; pest control; timber harvest; bridge replacement. Very sensitive to roost disturbance. Need more information about roosting requirements, particularly winter hibernacula. No major colony locations are known in Nevada – systematic surveys are critical.

Relevant References: Bradley and Ports (2005). Chung-MacCoubrey (1996), Deacon et al. (1964), Hall (1946), O'Farrell (2001c, 2002), O'Farrell and Studier (1973, 1975, 1980).


Known Distribution of *Myotis thysanodes* in Nevada
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Interstate and State Hwys
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Map compiled by the Nevada Natural Heritage Program, October 2005

Myotis velifer — cave myotis

Distribution: A single historical record (1964) from the southern portion of the Lake Mead National Recreation Area west of Lake Mojave. This mine was recently relocated and verified to still contain the species, although apparently numbers not high as what was previously reported (P. E. Brown and R. D. Berry, personal communication).

Habitat Characteristics: Found primarily at lower elevations in arid habitat dominated by creosote bush, palo verde, brittlebush, cactus, and desert riparian.

Resident Status: Summer resident.

Winter Status: Hibernates, but a few individuals have been found active in mines in winter (P. E. Brown, personal communication).

Roost Sites: Day roosts in caves and mines, and occasionally buildings and bridges. Tolerates summer roost temperatures as high as 37°C. Night roosts may be same structures used for day roosts, but locations nearest the entrance are preferred. Found repeatedly in swallow nests, particularly in non-reproductive season. Hibernacula elsewhere are generally mines or caves.

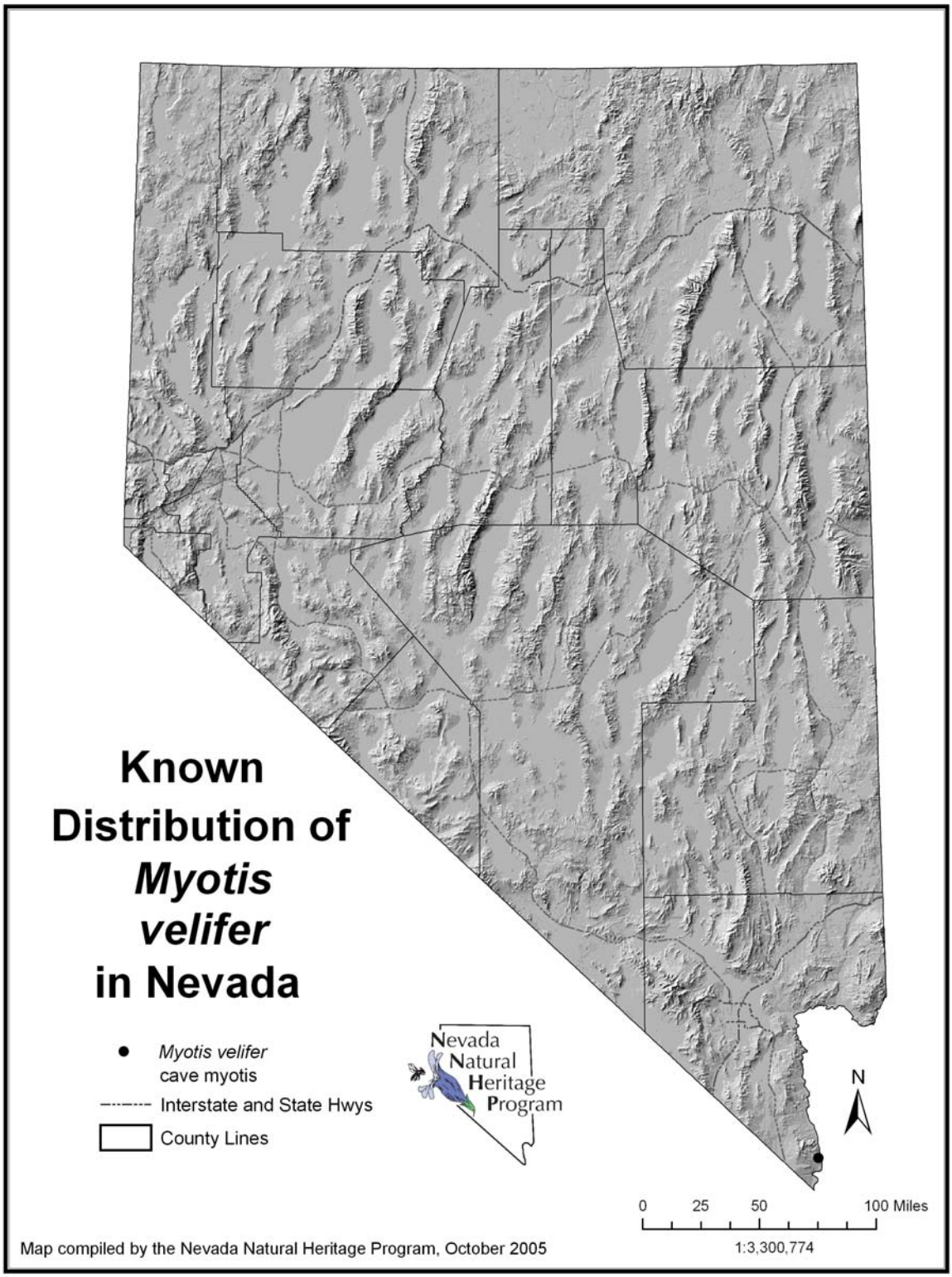
Reproduction: One young per year with birth occurring in June to July. Forms large maternity colonies numbering in the tens of thousands. Males roost in groups of usually less than 100 individuals. Hibernating groups contain both sexes.

Food Habits: Food items include moths and beetles. Foraging occurs in open areas near the edge or over vegetation.

Current Nevada Status: State unprotected. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S1.

Conservation/Management Issues: Loss of riparian habitat and intense agricultural conversion along the Colorado River; agricultural spraying; mine reclamation; renewed mining. Acquisition of current status information is critical. What little information is known suggests that this species is declining along the lower Colorado River. Based on guano piles and historical record, the one known Nevada colony seems to no longer support a large maternity colony. Impacts of grazing and riparian habitat management, winter range, and hibernacula requirements are not well known.

Relevant References: Cockrum and Musgrove (1964), Constantine (1958), Davis and Cockrum (1963), Fitch et al. (1981), Hall (1946), Jackson et al. (1982), Kunz (1974), Peckham (2005), Pitts and Scharninghausen (1986), Stager (1939), Vaughan (1959).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Map compiled by the Nevada Natural Heritage Program, October 2005

Myotis volans — long-legged myotis

Distribution: Found throughout the State but more widespread and common in the northern half. Occurs from mid to high elevations. Absent from the low desert.

Habitat Characteristics: Found in pinyon-juniper, Joshua tree woodland, and montane coniferous forest habitats. Occasionally found in Mojave and salt desert scrub (D. B. Hall, personal communication), and blackbrush, mountain shrub, and sagebrush. Current Nevada records indicate this species is distributed between 930-3,420 m (mean = 2,067 m $\pm$ 420 m).

Resident Status: Probably a year round resident.

Winter Status: Hibernates but has the capability of winter activity. It is suspected that there are elevational and latitudinal movements between summer and winter roosts. Transient colonies in the spring on the east side of the Sierra Nevada.

Roost Sites: Day roosts primarily in hollow trees, particularly large diameter snags or live trees with lightning scars. Also uses rock crevices, caves, mines, and buildings when available. Caves and mines may be used for night roosts. Hibernacula elsewhere are generally mines or caves.

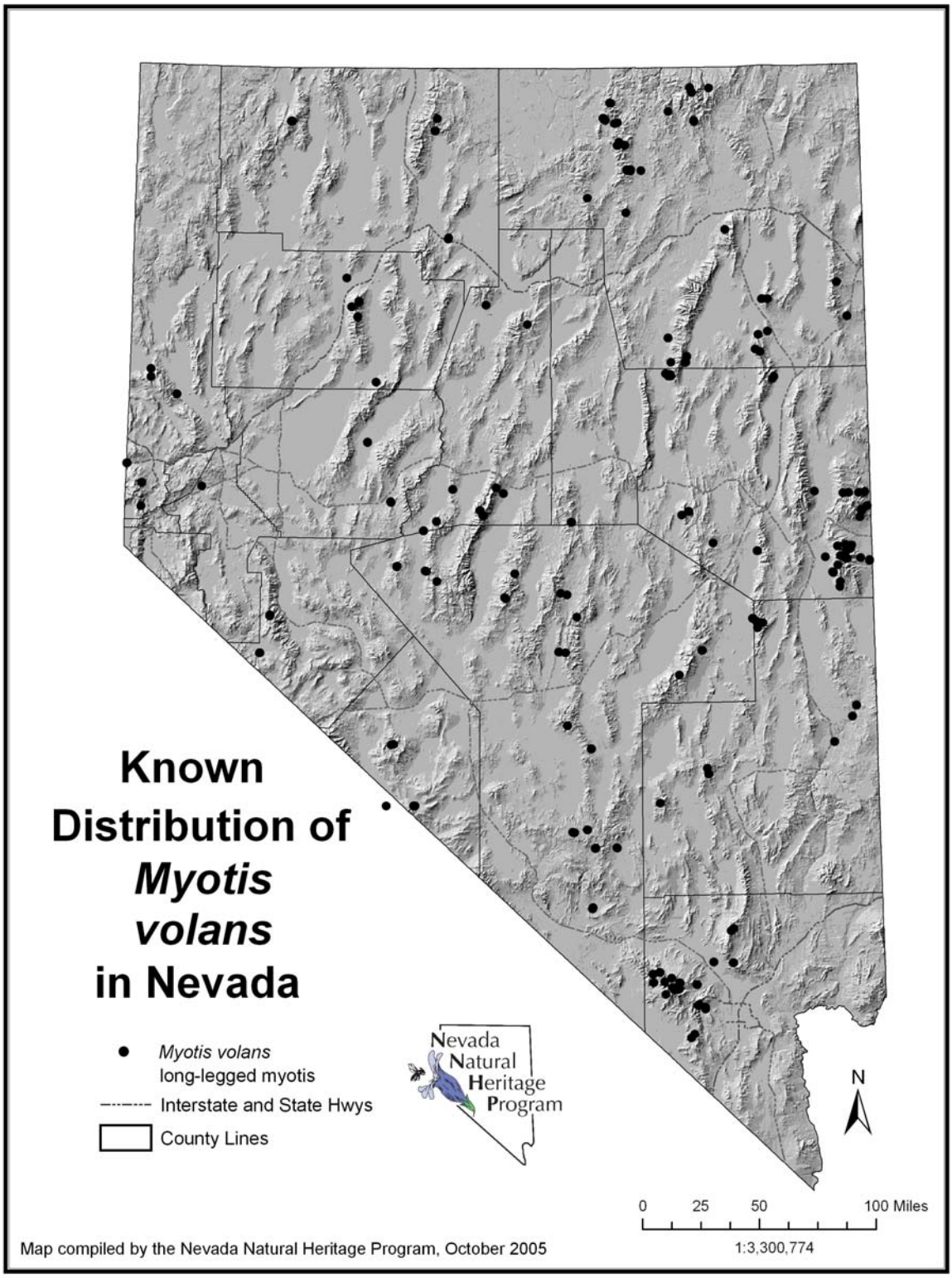
Reproduction: One young per year with birth occurring in June to July. Maternity colonies of up to 200-500.

Food Habits: Feeds primarily on moths but also feeds on other taxa, including beetles, flies and termites. Foraging occurs in open areas, often at canopy height.

Current Nevada Status: State unprotected. Population declines have been observed in the Spring Mountains of southern Nevada (M. J. O'Farrell, personal communication). Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S4.

Conservation/Management Issues: Timber harvest; aerial pesticide spraying; recreational caving; mine reclamation; renewed mining; water impoundments; building demolition and pest control. More information is needed about population trends, roost and foraging requirements, and use and acceptance of bat gates.

Relevant References: Bogan et al. (2005), Chung-MacCoubrey (1996), Fenton and Bell (1979), Hall (1946), Herder and Jackson (2000), O'Farrell and Bradley (1977), Ormsbee (1996), Ormsbee and McComb (1998), Ports and Bradley (1996), Saunders and Barclay (1992), Warner and Czaplewski (1984).


Known
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Myotis volans
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Interstate and State Hwys
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Map compiled by the Nevada Natural Heritage Program, October 2005

Myotis yumanensis — Yuma myotis

Distribution: Found at least in the southern and western half of the state, primarily at low to middle elevations. A recent collection in east central Nevada (M. J. O'Farrell, personal communication) and a large colony near Rye Patch Reservoir (P. E. Brown, personal communication) suggests a wider distribution in the state.

Habitat Characteristics: Found in a wide variety of habitats from low to mid-elevations, including sagebrush, salt desert scrub, agriculture, playa, and riparian habitats. One of the species that is most tolerant of human habitation and one of the few that thrives in a relatively urbanized environment. Although often considered to be a "building" bat, it is also found in heavily forested settings elsewhere. Current Nevada records indicate this species is distributed between 450-2,340 m (mean = 1,434 m ± 395 m).

Resident Status: Year round resident.

Winter Status: Hibernates. No large winter aggregations have been found in Nevada.

Roost Sites: Day roosts in buildings, trees, mines, caves, bridges, and rock crevices. Night roosts usually associated with buildings, bridges, or other man-made structures.

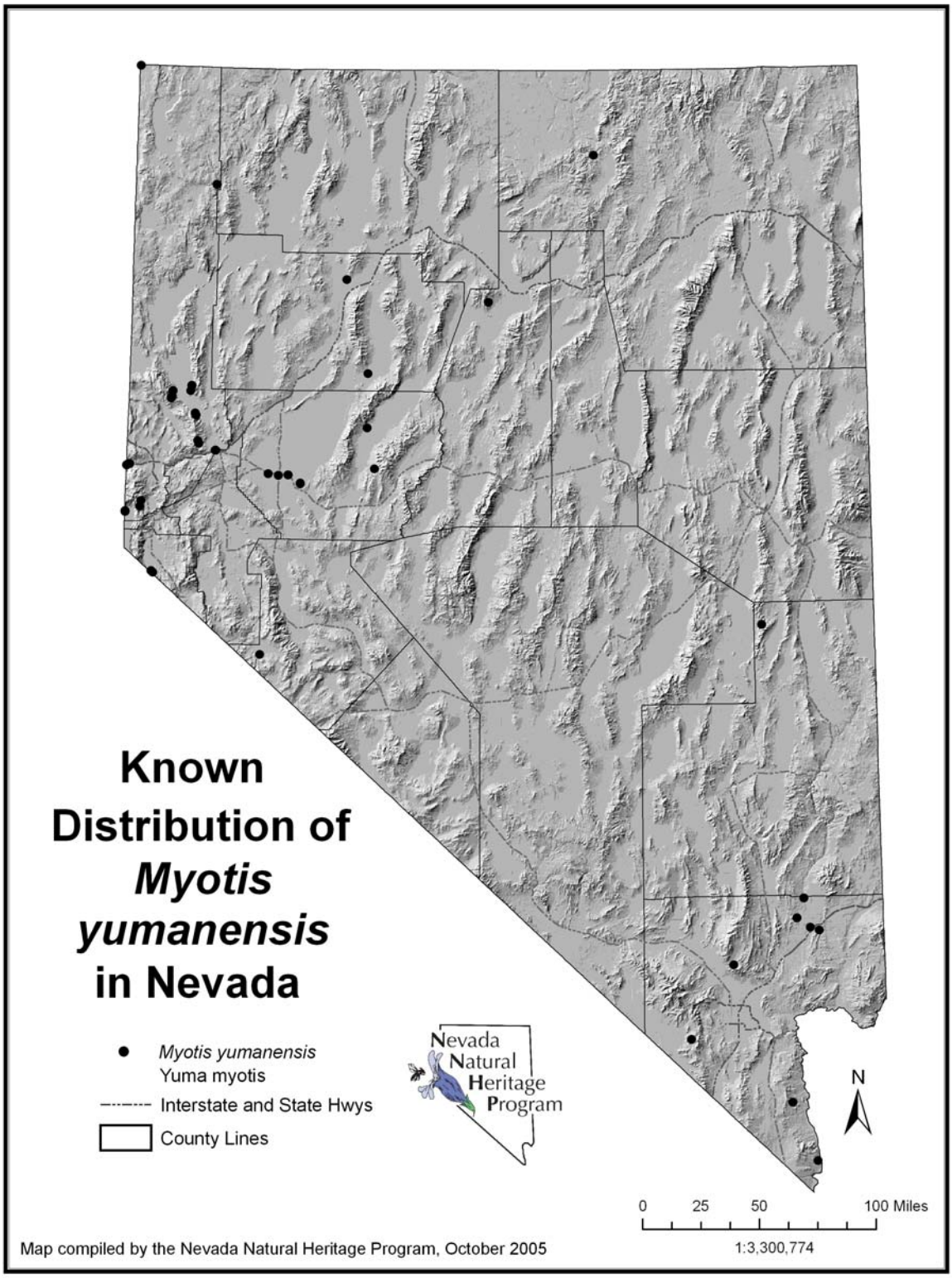
Reproduction: One young per year with birth occurring in June to July. Maternity colonies can be large (200 to several thousand) and contain only adult females and their young. Males roost singly or in small groups.

Food Habits: Feeds primarily on emergent aquatic insects, such as midges and caddis flies. Foraging occurs directly over the surface of open water and above vegetation. Usually found over relatively still water (e.g., ponds, reservoirs, or pools in streams and rivers.

Current Nevada Status: State unprotected. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S3S4.

Conservation/Management Issues: Timber harvest; building demolition; pest control exclusion; bridge replacement; mine reclamation; renewed mining; water impoundments. More information is needed about winter range and roost requirements and use and acceptance of bat gates. Can be confused with *Myotis lucifugus* (little brown bat).

Relevant References: Aldridge (1986), Betts (1997), Bogan et al. (2005), Brigham et al. (1992), Dalquest (1947), Hall (1946), Harris (1974), Herd and Fenton (1983), Hoffmeister (1986).


Known Distribution of *Myotis yumanensis* in Nevada
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Map compiled by the Nevada Natural Heritage Program, October 2005

Pipistrellus hesperus — western pipistrelle

Distribution: Found throughout most of the state, primarily in the southern and western portions. Most common in low and middle elevations (1,800 m), although occasionally found at higher elevations (>2,450 m).

Habitat Characteristics: Lower and Upper Sonoran desert habitats of blackbrush, creosote, salt desert shrub and sagebrush, with occasional occurrence in Ponderosa pine and pinyon-juniper, usually in association with rock features such as granite boulders and canyons. Current Nevada records indicate this species is distributed between 210-2,550 m (mean = 1,276 m ± 532 m).

Resident Status: Year round resident.

Winter Status: Hibernates but periodically arouses to actively forage and drink in winter.

Roost Sites: Day roosts primarily in rock crevices but may include mines, caves, or occasionally in buildings and vegetation. Generally roost singly or in small groups.

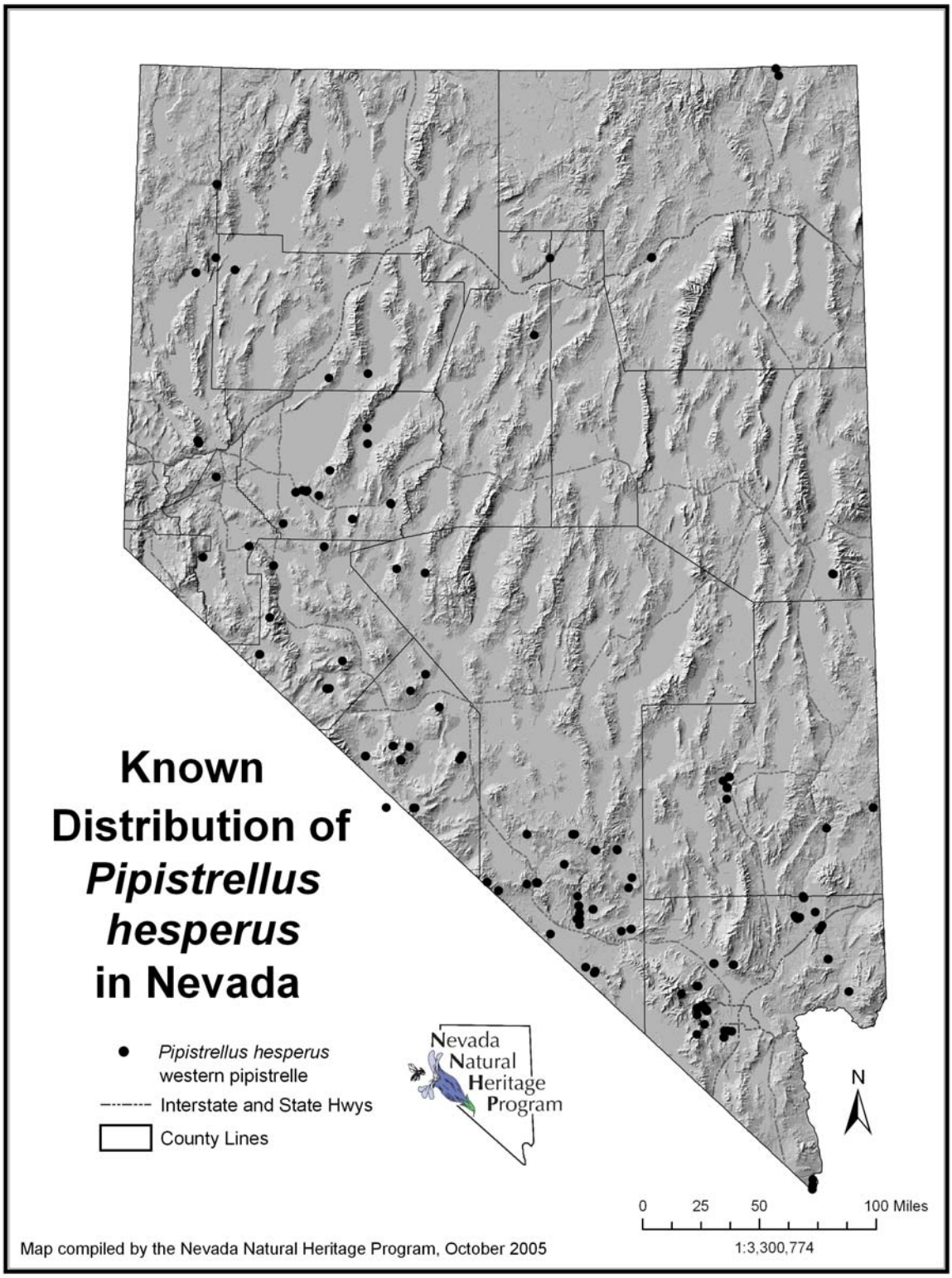
Reproduction: Two young per year with birth occurring in June. Females may form small maternity colonies, usually less than 12 individuals.

Food Habits: Food items include small moths, leafhoppers, mosquitoes, and flying ants. Foraging occurs in the open and is characterized by slow, erratic flight.

Current Nevada Status: State unprotected. Common in appropriate habitat. Population declines have been noted in the Spring Mountains in southern Nevada (M. J. O'Farrell, personal communication). BLM: Sensitive. NNHP: G5S4

Conservation/Management Issues: Destruction of roosting and foraging habitat by urban development; water impoundments; mine closure and reclamation. More information is needed about social structure, roost fidelity and microhabitat requirements, and foraging habits.

Relevant References: Bradley and O'Farrell (1969), Brown (2005), Cross (1965), Hall (1946), Hayward and Cross (1979), Koford and Koford (1948), Moor et al. (1965), O'Farrell and Bradley (1970, 1977), Stager (1943), Von Bloeker (1932).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Map compiled by the Nevada Natural Heritage Program, October 2005

Molossidae

***Eumops perotis* — western mastiff bat**

Distribution: Until recently, a single specimen found dead in Las Vegas in 1966 was the only known state record for this species. However, since 2001 multiple acoustic records of this species have been collected from the Spring Mountains (O'Farrell, 2002b), the Las Vegas Wash (M. J. O'Farrell, personal communication), Meadow Valley Wash (Tomlinson and Kenney, 2005), and along the Colorado River near Laughlin (Brown and Berry, 2003).

Habitat Characteristics: Found in a variety of habitats from desert scrub to chaparral to montane coniferous forest. Have been detected in montane meadows above 2,450 m. Distribution is tied to availability of suitable roosting habitat and can sometimes be predicted based on presence of significant rock features (e.g., large granite or basalt formations).

Resident Status: Probable transient.

Winter Status: Active all winter at lower elevations.

Roost Sites: Day roosts primarily in crevices in cliff faces and cracks in boulders, occasionally buildings. Generally roost in groups less than 100.

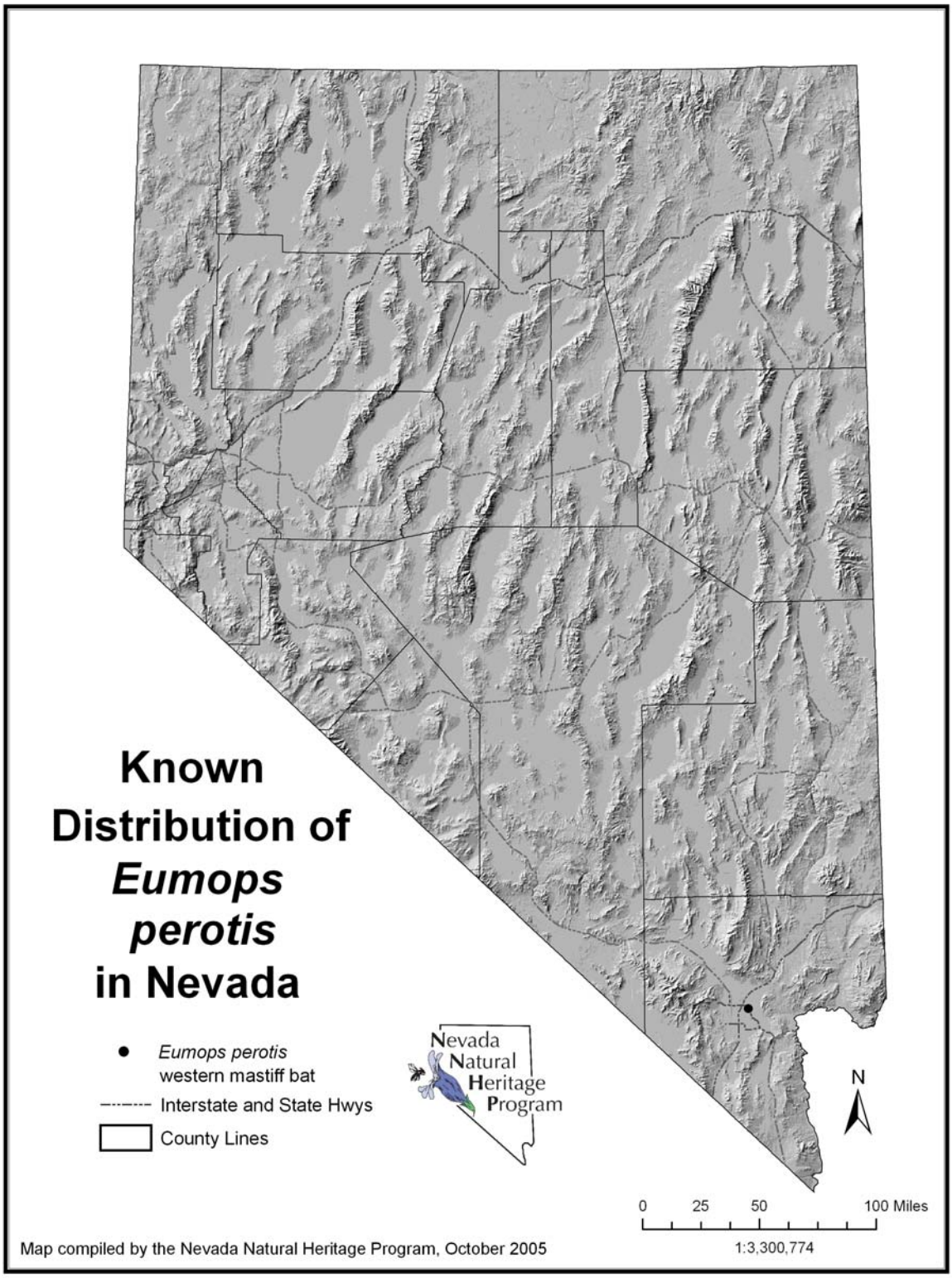
Reproduction: One young per year, with birth occurring in June to July. Females form maternity colonies of thirty to several hundred individuals, although adult males are sometimes present.

Food Habits: Diet appears to be primarily moths, but also includes beetles and crickets in California. Foraging occurs in the open and ranges to high altitude (300 m above ground). Some individuals are known to travel more than 40 kilometers (km) to reach feeding grounds. Detected most frequently over desert washes, grasslands, or meadows but also feeds above the forest canopy.

Current Nevada Status: State unprotected. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S1.

Conservation/Management Issues: Recreational climbing; water impoundments; pest control exclusion; building demolition; highway projects; loss of foraging habitat due to urban/suburban expansion; agricultural spraying. Surveys are needed to delineate state range, the presence and distribution of breeding colonies, seasonal movements, and roosting and foraging requirements.

Relevant References: Bradley and O'Farrell (1967), Brown and Berry (2003), Dalquest (1946), Krutzsch (1955), Leitner (1966), O'Farrell (2002b), Pierson and Rainey (1995), Siders (2005), Tomlinson and Kenney (2005), Vaughan (1959).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Nyctinomops macrotis — big free-tailed bat

Distribution: Found in the southern portion of Nevada, from one location in the Las Vegas area and the other a historical unspecified locality. Detected acoustically in moderate numbers within the Muddy River drainage from September through October 2000, and again within the same months in 2001 (Williams, 2001). During July through September 2003, detected acoustically in Meadow Valley Wash, Eagle Valley, and Clover Creek in Lincoln County (Tomlinson and Kenney, 2005)

Habitat Characteristics: Associated primarily with very rocky country (canyon lands). Found in arroyo, scrub desert, riparian areas, woodland habitats, although generally a floodplain-arroyo association. Typically low elevation, although has been found to 2,450 m in New Mexico, and in higher elevation conifer forest in northern Arizona.

Resident Status: Transient but possible summer resident. Records for this species are sparse and scattered.

Winter Status: Probably does not hibernate.

Roost Sites: Day roosts primarily in crevices in cliff faces, although occasionally in buildings and caves. Generally roost in groups less than 100.

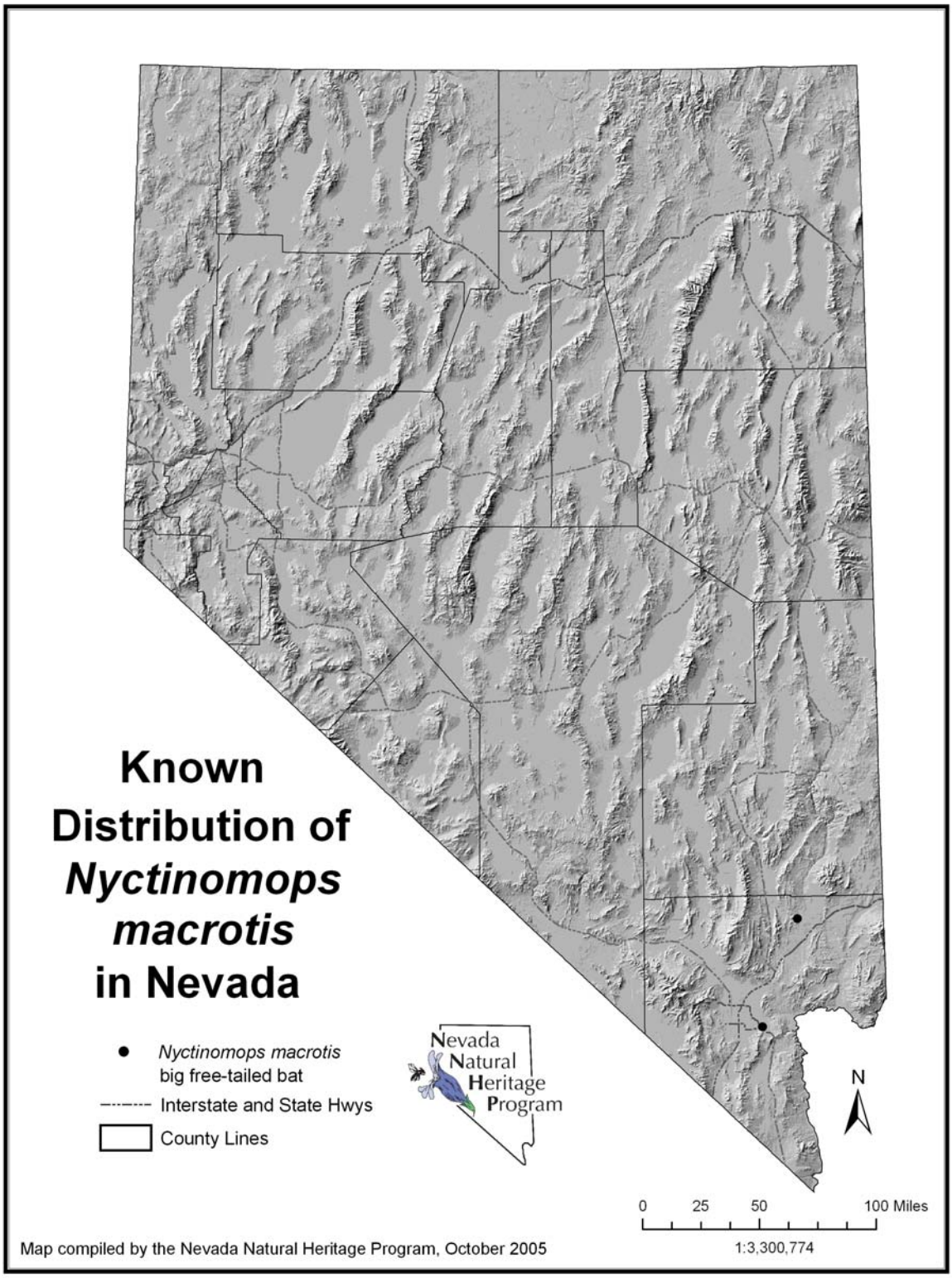
Reproduction: One young per year, with birth occurring in June to July. Females form maternity colonies, males appear to be segregated.

Food Habits: Food items include a variety of insects but moths predominate. Foraging occurs in the open and ranges to high altitude.

Current Nevada Status: State unprotected. Known from very few records and appears to be rare. Formerly a Category 2 Candidate for federal listing as Threatened or Endangered. BLM: Sensitive. NNHP: G5S1S2.

Conservation/Management Issues: Recreational climbing; water impoundments; pest control exclusion; highway projects; loss of foraging habitat due to urban/suburban expansion; agricultural spraying. More information is needed on roosting ecology, seasonal movements, and presence and distribution of breeding colonies. Surveys are needed to delineate state range.

Relevant References: Bradley et al. (1965), Easterla (1973), Easterla and Whitaker (1972), Hall (1946), Huey (1932), Milner et al. (1990), Navo (2005), Pierson and Rainey (1995), Tomlinson and Kenney (2005), Williams (2001).


Known
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big free-tailed bat
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Map compiled by the Nevada Natural Heritage Program, October 2005

Tadarida brasiliensis — Brazilian free-tailed bat

Distribution: Found through most of the state, ranging from low desert to high mountain habitats.

Habitat Characteristics: Found in a wide variety of habitats. Although predominantly a lower elevation species has been found from 220 to > 3,500 m in the Sierra Nevada. Recent acoustic surveys reveal it is more widespread and common, at least in southern Nevada, than previously thought. Current Nevada records indicate this species is distributed between 210-2,550 m (mean = 1,260 m ± 562 m).

Resident Status: Summer resident. Recent observations suggest pockets of year-round residents in southern Nevada (M. J. O'Farrell, personal communication).

Winter Status: Migrations of 1,840 km are documented for this species (Wilkins, 1989). Migrates away from colder regions and winters in areas with predominantly non-freezing temperatures but has been found to hibernate in northern California. Migratory animals appear to be active in the winter range. Winter activity has been observed recently in the low desert of southern Nevada.

Roost Sites: Select a variety of day roosts including cliff faces, mines, caves, buildings, bridges, and hollow trees. Although colonies number in the millions in some areas, colonies in Nevada are generally several hundred to several thousand (largest known colonies have been estimated at ca. 70,000-100,000). Some caves may be used as long term transient stopover roosts during migration. For example, some evidence suggests that the colony at Rose Cave arrives in July and departs in mid October.

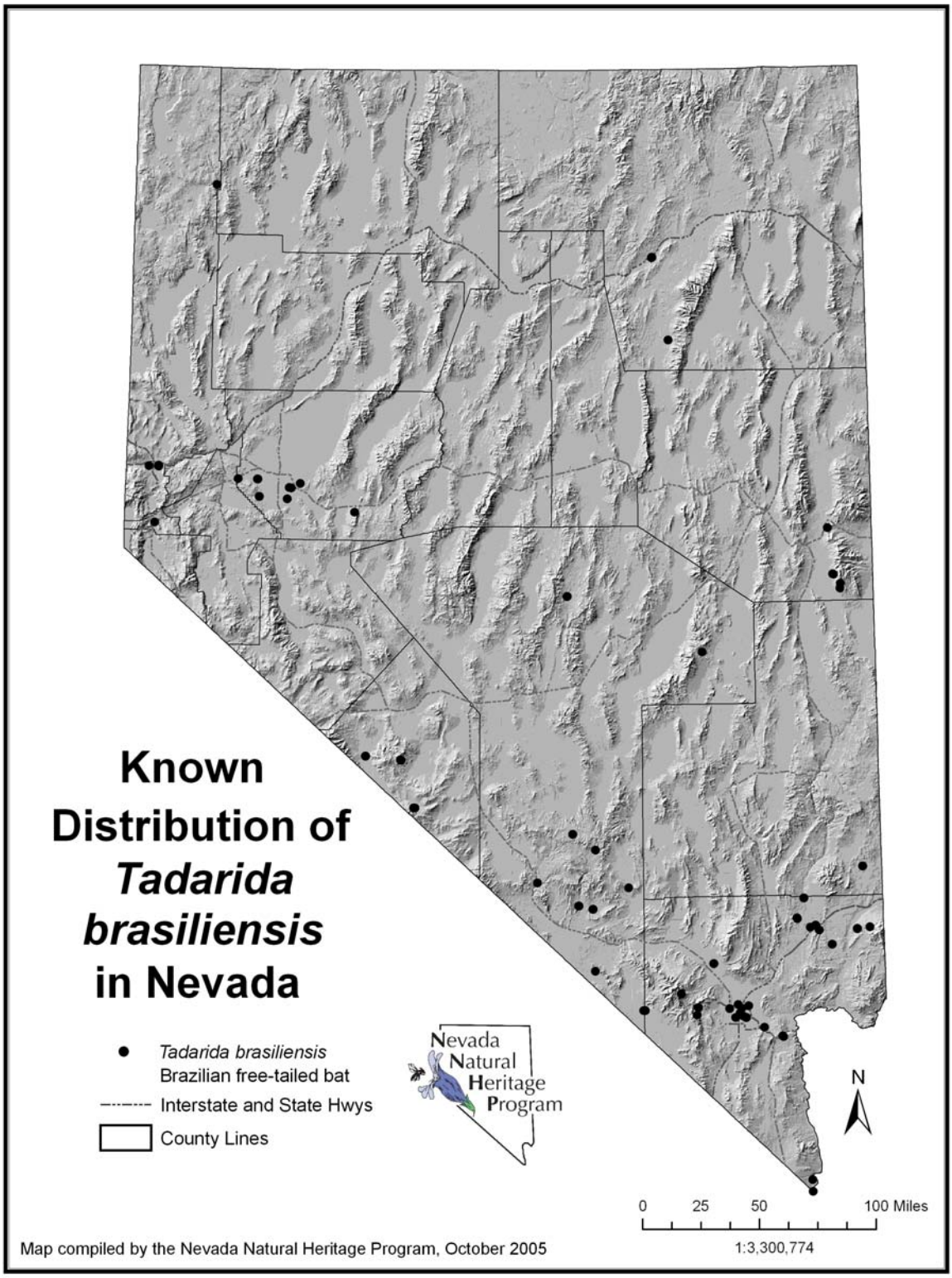
Reproduction: One young per year, with birth occurring in June to July. Females form large maternity colonies, males segregate and may form smaller bachelor colonies.

Food Habits: Food items include a variety of insects but moths predominate. Foraging occurs in the open and may range to high altitudes. Some individuals are known to travel more than 40 km to reach feeding grounds and feed more than 300 m above the ground.

Current Nevada Status: State Protected. Although *Tadarida brasiliensis* is one of the most common species in much of the west, its numbers may be well below what they were historically. A large population decline has been documented for the Rose Guano Cave, near Ely. The decline is likely due to the introduction of a second entrance, thereby altering the cave microclimate and allowing for easy access by humans (P.V. Bradley, personal communication). The artificial adit entrance was sealed in October 1996 in an attempt to reverse the declining population trend. BLM: Sensitive. NNHP: G5S3S4.

Conservation/Management Issues: Recreational caving; mine reclamation; renewed mining; historical guano mining; water impoundments; agricultural spraying; bridge replacement; pest control exclusion; highway projects; loss of foraging habitat due to urban/suburban expansion. More information is needed on seasonal patterns. The tendency of this species to roost in very large colonies makes it especially vulnerable to disturbance.

Relevant References: Adams and Hayes (2000), Barbour and Davis (1969), Bat Conservation International (2005), Brittingham and Williams (2000), Clark et al. (1996), Cockrum (1969), Constantine (1967), Hall (1946), Hoff et al. (1993), Keeley and Tuttle (1999), McCracken (1996), O'Farrell (1998), Simmons et al. (1978), Roberts et al. (1997), Romano et al. (1999), Texas Parks and Wildlife (2000), Thies et al. (1996), Wilkins (1989).


Known Distribution of *Tadarida brasiliensis* in Nevada
Tadarida brasiliensis
Brazilian free-tailed bat
Interstate and State Hwys
County Lines
Nevada Natural Heritage Program
N
0 25 50 100 Miles
1:3,300,774
Map compiled by the Nevada Natural Heritage Program, October 2005

To create the range maps, records of Nevada's 23 species of bats were compiled from a variety of sources from 1928 to 2002 [Hall (1946), Nevada Department of Wildlife, Nevada Natural Heritage Program, Nevada State Museums (Carson City and Las Vegas), University of California-Berkeley (Museum of Vertebrate Zoology), University of Nevada-Reno (Department of Biology), and unpublished data sources (P. E. Brown, M. J. O'Farrell, M. Rahn and J. A. Williams)]. Only those records with reliable location data were included in the distribution maps. Gaps in knowledge exist in those areas where no records for bats currently occur (Figure 24). It is reasonable to assume that these areas have not been adequately surveyed.

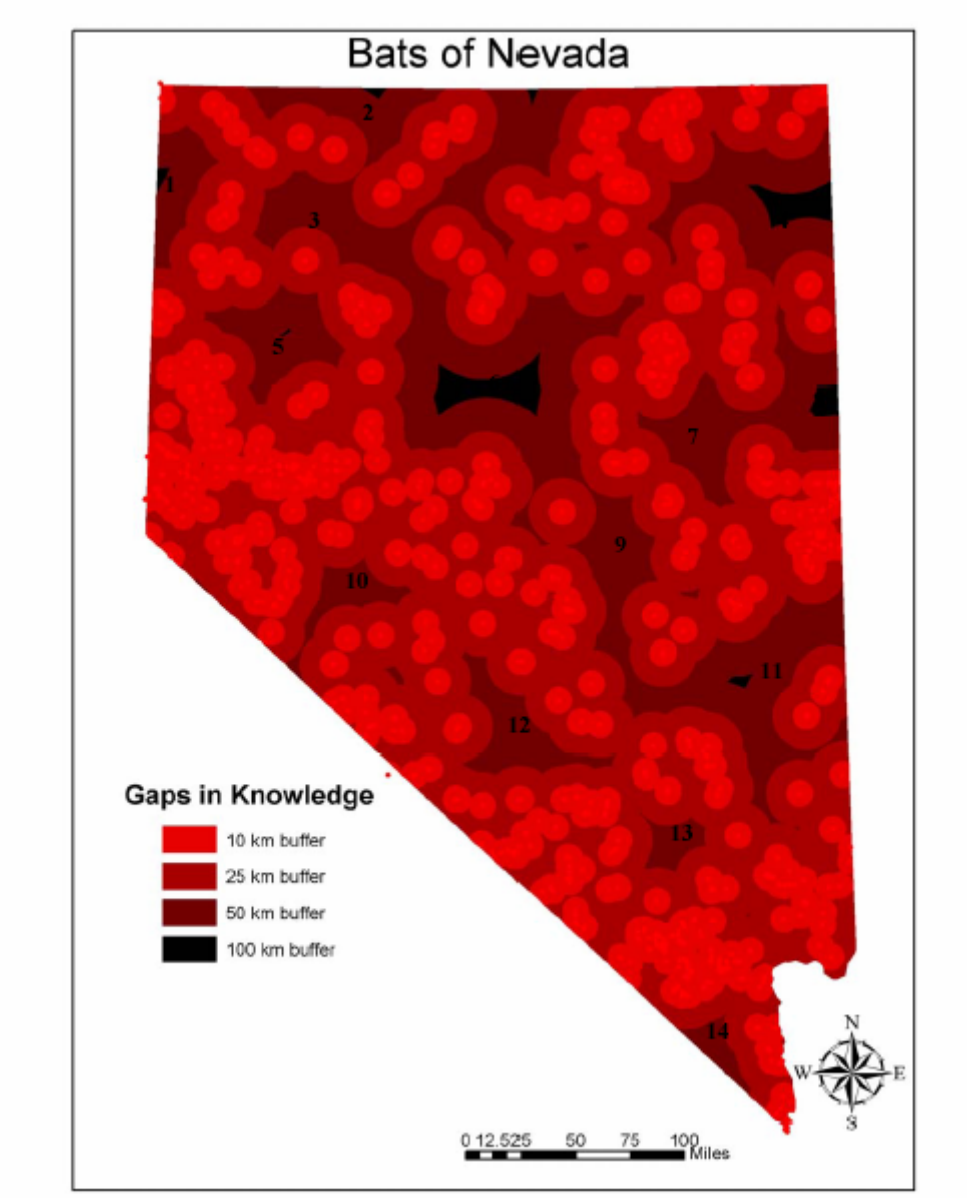


Figure 24. Distribution of all known bat records in Nevada (n=5,148) and the associated gaps in knowledge. These gaps should be considered a high priority for future surveys.

Eight bats should be considered widely distributed throughout the State: pallid bat, Townsend's big-eared bat, big brown bat, hoary bat, silver-haired bat, western small-footed myotis, long-eared myotis, and long-legged myotis. Six species have distributions limited to only the southern portion of the State: Mexican long-tongued bat, western mastiff bat, Allen's big-eared bat, western yellow bat, California leaf-nosed bat, and big free-tailed bat. Of these, Mexican long-tongued bats, western mastiff bats, western yellow bats, California leaf-nosed bats, cave myotis, and big free-tailed bat*s* are known from only a few localities. Six species have unusual distributions in the state: 1) those with a majority of their records in the western and southern portions of the State, although there are records throughout the State (California myotis, fringed myotis, and western pipistrelle); 2) those having a northern distribution (little brown bat); 3) those having very few records in the northern portion of Nevada (Mexican free-tailed bat); and 4) those species having a patchy distribution, being distributed throughout most of the State but having a majority of the records concentrated in a few areas (Yuma myotis). Finally, there is insufficient data to determine an overall distribution pattern for spotted bats and western red bats.

Summary of Threats

Threats facing Nevada's 23 bat species can be categorized into those that are primarily human-induced (anthropogenic) and those resulting from natural events and/or the natural history of the species. Threats can be further categorized as those with the potential to affect bat habitats (roosting, foraging, or migration corridor habitats) and those that would have the potential to cause direct bat population declines with no disturbance of habitats. All threats have the potential to affect roosting, foraging or migrating segments of the population. Many threats are interrelated, further complicating conservation issues.

Anthropogenic Threats

1) **Abandoned Mine Closures** - Indiscriminate closure of abandoned mines is recognized as a threat to bats and their habitats. **Fix** - Bat-friendly closure techniques (fencing, hazard signs and gating) should be employed wherever possible. When hard closure techniques are the only option, adequate and proper bat surveys should precede any closure project. When bats are found, proper bat exclusion and off-site mitigation should precede any hard closure project.
2) **Renewed Mining in Historical Mine Sites –** Contemporary open pit gold mining often is associated with historical mining districts. Bat habitats have been destroyed when pits have come into contact with and/or totally removed historical mine workings (Brown, 1995). **Fix** – On-site bat exclusion and off-site mitigation.
3) **Camping** – When conducted in inappropriate areas, such as within and near riparian habitat, loss of important foraging habitat occurs. **Fix** – Education (See Strategies) and limitation of camping in or near riparian habitat that has been identified as key foraging or roosting sites.
4) **Eradication** – State funded projects designed to protect the public from rabies transmission target the elimination of bat colonies. **Fix** – Education.
5) **Inventory, Monitoring, and Scientific Research** – Research activities can depress, scatter or extirpate populations of sensitive bat species if conducted inappropriately (Perkins and Schommer 1991). **Fix** – Standardized survey protocol and, new non-intrusive, coordinated survey techniques (new permit requirements may be incorporated).
6) **Livestock Grazing** – Certain livestock grazing practices have contributed to the large-scale conversion of mesic riparian bat habitats (Swift, 1984) and xeric upland bat habitats to unproductive wildlife habitat. **Fix** – Improve stewardship of riparian and upland habitats on public and private lands throughout Nevada. Education.
7) **Off-Highway Vehicle Travel –** When conducted in inappropriate areas, such as within and near riparian habitat, loss of important foraging habitat occurs. **Fix** – Education and limitation of OHV travel in or near riparian habitat.
8) **Pesticide Spraying – Indirect –** Non-target insecticide sprays reduce numbers and species of insects available to bats (Brown and Berry, 1991). **Direct** – Bats may be at risk of direct poisoning as a result of their diets, high metabolic rates, high food intake and high rates of fat mobilization

during migration, lactation and hibernation (Clark, 1988). **Fix** – Additional research and education (i.e. bats as an alternative to chemical insecticides).

9) **Recreational Caving and other Direct Human Disturbance –** Human disturbance during critical maternity, hibernation and leking time periods can depress, scatter and extirpate bat populations (Pierson and Rainey, 1996). **Fix** – Seasonal closures, education and research to determine degree of impacts.
10) **State Regulatory Status –** Fourteen bat species remain unprotected by Nevada State Statute. In Nevada, an individual requires no hunting license to kill unprotected animals (Nevada NRS). **Fix** – Change NRS.
11) **Timber Harvest –** Timber harvest impacts roosting and foraging habitats (Barclay and Brigham, 1996). **Fix** - Modify timber harvest techniques where significant bat roosting and foraging habitats exist and better assess bat use of these habitats in Nevada.
12) **Toxic Material Impoundments –** Lethal concentrations of cyanide in ponds and atop ore piles associated with the processing of gold ore, killed at least 158 bats (species not identified) between 1986 and 1989 (Nevada Department of Wildlife, unpublished data). **Fix** – Preclude access to toxic impounds (using *exclusion netting, etc*) and chemical neutralization of cyanide.
13) **Urban Development –** Loss of habitat to urban development removes natural foraging and roosting habitat. **Fix** – Education. Limit urban development in or around key areas, such as riparian habitat and colonial roosting locations.
14) **Bridge/Highway Construction and Maintenance –** Certain bridges in Nevada provide critical roosting sites for bats. For example, our largest colony of Mexican free-tailed bats occurs in an urban bridge. Loss of these roosting structures can significantly impact bats. **Fix** – Partner with Nevada Department of Transportation and local municipalities to ensure that existing roosting habitat is maintained and during new construction, roosting habitat can be created if appropriate.
15) **Vegetative Conversion/Invasive Species –** Millions of acres of native shrub steppe and thousands of acres of pinyon-juniper habitats have, through the agents of fire, livestock grazing, and mechanical and chemical vegetation manipulation, been permanently converted to monotypic exotic grasslands (*Bromus* and *Agropyron*). Several insect species, which bats rely on for food, such as most *Lepidopterans,* reproduce on shrubs, trees and flowering plants, and not on grasses. **Fix** - Stop the conversion to exotic grasslands and attempt to rehabilitate those areas from exotic to native rangelands.
16) **Water Source Development –** Manipulation of water sources, such as natural springs and seeps, through ground water pumping or development for livestock and wild ungulate use can alter or reduce the amount of natural vegetation available for bats to forage over. Large-scale water transfers and pipelines may also be a significant threat to bats. **Fix** – Education. Research to determine the degree of impacts groundwater pumping has on riparian habitat loss. Partner with appropriate management agencies to ensure that bat conservation is considered in water development projects.
17) **Artificial Water Sources –** Artificial water sources can injure or kill bats if not properly designed and maintained. **Fix –** Ensure that all artificial water sources have a properly installed and designed escape ramp and avoid the use of any obstacles to bats flight paths, such as wooden or wire braces, whenever possible.
18) **Wind Energy Development –** Although research is preliminary (Arnett, 2005), it seems that some species of bats are highly susceptible to injury and death due to collisions with wind turbines. This is especially true for migrating species. Difficulty of detecting dead bats at wind turbine sites complicates this issue. **Fix** – Rigorous monitoring should be included in any wind turbine project to learn to what degree wind turbines are having an effect on local bat populations. As more details are learned, management and mitigation can be designed accordingly.

Natural Threats

1) **Behavioral Ecology** – The roosting behavior of most bats makes them highly vulnerable to disturbance. Such congregations place a large proportion of the population at risk from a single disruptive event. **Fix** – Protect roosts, and limit opportunities for anthropogenic disturbance.
2) **Population Ecology** – Low birth rates, high infant mortality, high roost fidelity, high longevity make most bat populations vulnerable to roost and foraging habitat disturbances and limits their ability to rebound quickly from population declines. **Fix** – Protect roosts and foraging habitats and limit opportunities for anthropogenic disturbance.
3) **Habitat Threats** – The loss of roosting and foraging habitats to natural erosion and fire is a factor. **Fix** – Rehabilitate areas damaged by fires and erosion.
4) **Predation** – Minor predation of bats by snakes, birds of prey and carnivores has been documented in Nevada. **Fix** – None – this is part of the natural ecosystem.

Current Agency Designations for Bats Occurring in Nevada:

Scientific Name	Common Name	USFWS	BLM	USFS	State	Grank	Srank
Choeronycteris mexicana	Mexican long-tongued bat	xC2				G4	SA
Macrotus californicus	California leaf-nosed bat	xC2	N,C	C	Sensitive	G4	S2
Antrozous pallidus	pallid bat		N,C	I	Protected	G5	S3
Corynorhinus townsendii	Townsend's big-eared bat	xC2	N,C	S,I,L	Sensitive	G4	S2
Eptesicus fuscus	big brown bat		N			G5	S4
Euderma maculatum	spotted bat	xC2	S	S	Threatened	G4	S2
Idionycteris phyllotis	Allen's big-eared bat	xC2	N		Protected	G3G4	S1
Lasionycteris noctivagans	silver-haired bat		N			G5	S3
Lasiurus blossevillii	western red bat		N	I	Sensitive	G5	S1
Lasiurus cinereus	hoary bat		N			G5	S3
Lasiurus xanthinus	western yellow bat					G5	S1
Myotis californicus	California myotis		N			G5	S4
Myotis ciliolabrum	western small-footed myotis	xC2	N,C			G5	S3
Myotis evotis	long-eared myotis	xC2	N,C			G5	S4
Myotis lucifugus	little brown bat		N			G5	S3
Myotis thysanodes	fringed myotis	xC2	N,C		Protected	G4G5	S2
Myotis velifer	cave myotis	xC2	N,C			G5	S1
Myotis volans	long-legged myotis	xC2	N			G5	S4
Myotis yumanensis	Yuma myotis	xC2	N,C			G5	S3S4
Pipistrellus hesperus	western pipistrelle		N			G5	S4
Eumops perotis	greater western mastiff bat	xC2	N,C		Sensitive	G5	S1
Nyctinomops macrotis	big free-tailed bat	xC2	N			G5	S1S2
Tadarida brasiliensis	Brazilian free-tailed bat		N		Protected	G5	S3S4

U. S. Fish and Wildlife Service (**USFWS**) Categories for Listing under the Endangered Species Act:

- <C2 Former USFWS Category 2 Candidate, now species of concern

Bureau of Land Management (**BLM**) Species Classification:

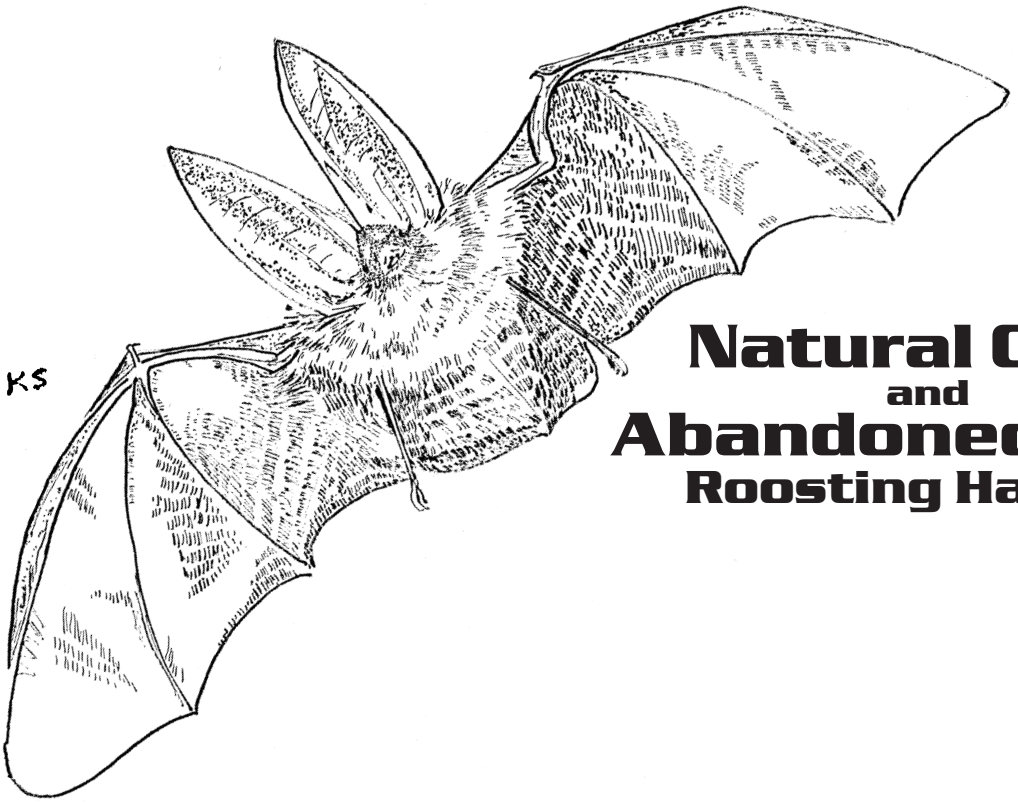
- S Nevada Special Status Species - USFWS listed, proposed or candidate for listing, or protected by Nevada state law
- N Nevada Special Status Species - designated Sensitive by State Office
- C California Special Status Species (see definition S and N)

United States Forest Service (**USFS**) Species Classification:

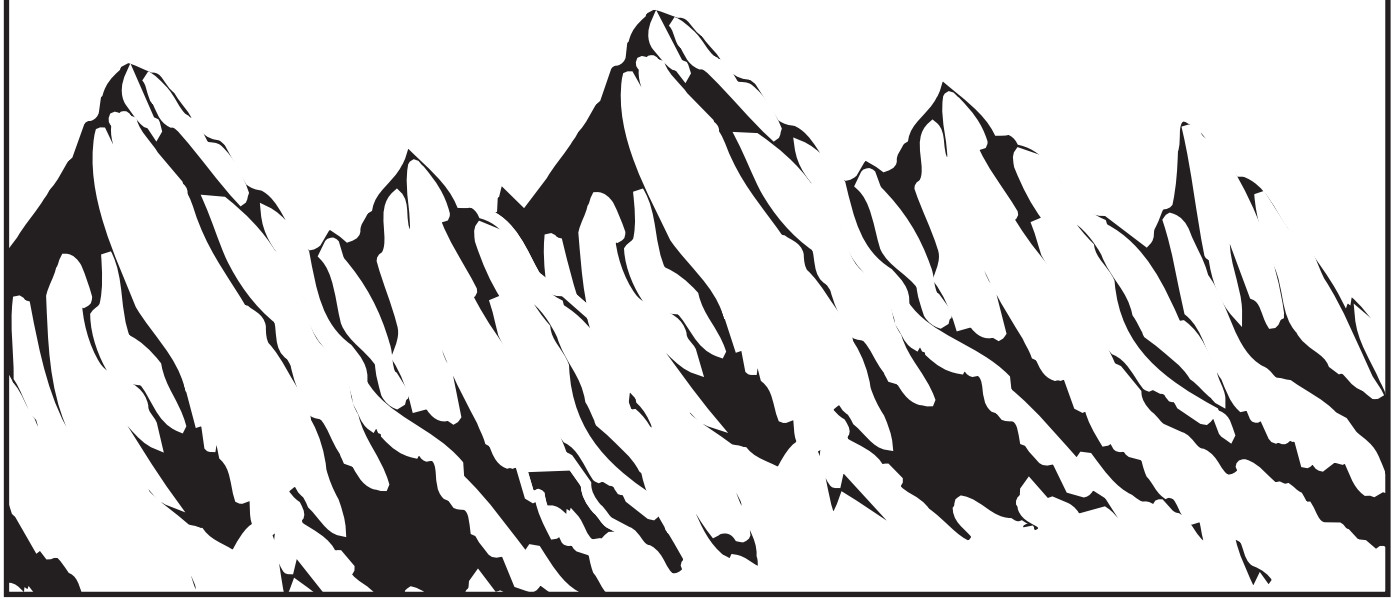
- S Region 4 (Humboldt-Toiyabe NF) sensitive species
- I Region 5 (Inyo NF) sensitive species
- L Region 5 (Lake Tahoe Basin Management Unit) sensitive species
- C Region 5 sensitive species, not yet known from Inyo NF or Lake Tahoe Basin Management Unit

Nevada Natural Heritage Program Global (**Grank**) and State (**Srank**) Ranks for Threats and/or Vulnerability:

- G Global rank indicator, based on worldwide distribution at the species level
- T Global trinomial rank indicator, based on worldwide distribution at the subspecific level
- S State rank indicator, based on distribution within Nevada at the lowest taxonomic level
  - I Critically imperiled and especially vulnerable to extinction or extirpation due to extreme rarity, imminent threats, or other factors
  - 2 Imperiled due to rarity or other demonstrable factors
  - 3 Vulnerable to decline because rare and local throughout its range, or with very restricted range
  - 4 Long-term concern, though now apparently secure; usually rare in parts of its range, especially at its periphery
  - 5 Demonstrably secure, widespread, and abundant
    - A Accidental within Nevada
    - B Breeding status within Nevada (excludes resident taxa
    - H Historical; could be rediscovered
    - N Non-breeding status within Nevada (excludes resident taxa)



Natural Cave
and
Abandoned Mine
Roosting Habitat










CONSERVATION STRATEGY

Introduction

Bats are distributed across the entire State from 150 m above sea level along the Colorado River to nearly 4,000 m on the flanks of Boundary Peak and Mt. Wheeler, Nevada's tallest mountains. Bats use all known Sierra Nevada, Great Basin and Mojave Desert habitats in Nevada, including salt desert scrub, sagebrush steppe, riparian, pinyon-juniper woodland, mountain brush, aspen, subalpine coniferous forest, and alpine tundra. Local populations of some species, apparently abundant historically, appear to have declined dramatically in modern times (P. V. Bradley, P. E. Brown, and M. J. O'Farrell, personal communication). Local populations of other species may have benefited from the activities of man. Regardless, the intent of the Conservation Strategy portion of this Plan is to use what we currently know about the biological needs of bats to help guide managers in the conservation, preservation, protection, management and restoration of bat species and their habitats in the State.

Bat Habitat Conservation Guilds

NATURAL CAVE, MINE SHAFT AND MINE ADIT ROOSTING HABITAT (CA)

General Distribution

Natural caves are found throughout Nevada. The highest concentration of caves is found in sedimentary deposits, particularly those deposits where limestone solution processes have carved caverns in the parent rock. Igneous deposits, primarily volcanic deposits, also contain a substantial number of natural caves or hollow tubes formed by flowing lava and natural fracturing. Metamorphic parent rock types provide the lowest number of natural caves in Nevada although fracturing occasionally produces suitable cave formations.

There are an estimated 200,000 to 300,000 historical mining features in Nevada (Durbin and Coyner, 2002). Historical mines are found across the State wherever hard rock mining districts occur. Historical mine distribution does not mirror natural cave distribution and occurs in almost all rock types. As compared to the surrounding landscape, caves, shafts and adits are the rarest of all wildlife habitat types in the intermountain west and likely comprise less than 0.01% of the total habitat available. Many cave and mine features are not used by bats due to a variety of factors such as lack of available shelter, unsuitable microclimate, and human disturbance. Therefore, availability is much less than sheer numbers would indicate. In addition, there is new evidence that caves and mines are not equivalent in the eyes of bats. R. E. Sherwin (personal communication) and J. S. Altenbach (personal communication) are finding drastic differences in roost characteristics between mines and caves.

Physical Characteristics

Cave, shaft and adit habitats range in elevation from 150 m along the Colorado River to near 4,000 m on Boundary Peak and Wheeler Peak. Annual precipitation varies accordingly from less than 10 cm in the south to over 80 cm on the higher mountains of the north and can come in the form of rain or snow anywhere in the State. Soil types range across the spectrum from fine clays to coarse gravels.

Cave, shaft and adit habitats can be simple or complex. The longer adits and those with a greater number of vertical and horizontal connections to the surface are generally the more complex habitats and seem to be preferred by bats, especially for hibernating and maternity sites. Simple structures can also be very important though and are necessary for several species during certain parts of their life cycles.

In complex systems, geologic features creating air traps can yield drastically different air temperatures compared to outside ambient temperatures, as well as serve as sources for concentrated gases. Multiple entrances can result in greater air flow into and through the structure affecting the internal microclimate. Geothermal heating can also affect internal microclimate.

Dominant Plant Species

With the exception of algae growth in some artificially lighted caves, plants do not occur in this habitat type. Plant composition at surface openings varies with elevation, precipitation, latitude and longitude.

Historical and Current Condition

Natural caves, mine shafts and adits found in more erosion-resistant rock types tend to be those with greater life expectancy. For example, an underground silver mine constructed in erosion-resistant limestone will generally have much greater longevity than a silver mine located in a decomposing granite rock type.

Recreational caving in natural caves and historical underground mines has increased in some areas dramatically over the last 30 years (Great Basin National Park, unpublished data; BLM, personal communication). As such, increased human disturbance in the form of non-natural light sources, elevated noise levels, soil and structure disturbance and vandalism have altered many of these habitats. Population growth in Nevada, particularly in western and southern Nevada, has been unparalleled. Communities continue to encroach into areas containing caves and abandoned mines, creating easy access for exploration. The expansion of the human population also accounts for greater use of wildlands and more visitations to caves and abandoned mines. Vandalism is a direct product of this increased exposure to the public.

Internal survey and inventory work inappropriately conducted during critical stages in the life history of bats, particularly maternity and hibernation periods, may also have a negative effect on bat populations. Therefore it is important to make sure that only qualified persons conduct surveys and that survey efforts are coordinated throughout the state to minimize overlap and excessive disturbance.

Increased or renewed mining may have deleterious effects on populations of bats. Contemporary open-pit mining operations are often located in historical mining districts. In situations where historical adits and shafts are carved away by the expansion of an open-pit mine, these habitats are lost permanently. In other areas adjacent to renewed mining, disturbance to foraging areas and direct disturbance to bats can cause serious declines in populations, alter species composition or cause an entire roost to be abandoned. Some effective mitigation in these situations has occurred.

Human safety concerns have led to an increased emphasis on permanently closing abandoned mines. In the early 1990s, it became apparent that permanent, hard-closure techniques had been used to close adits and shafts in Nevada with no prior bat surveys. Successful efforts among federal and state entities and professionals that study bats in the last few years have increased the level of interagency communication and the recognition that bats must be accounted for in abandoned mine closure programs.

Estimates can differ substantially in the number of abandoned mines that provide suitable bat habitat. However, from surveys of hundreds of mining districts across the west, scientists have estimated that approximately 70% of adits and shafts in some areas may provide bat roosting habitat in the form of either maternity, hibernation, night and/or lek roosts (R.E. Sherwin, unpublished data; P.E. Brown, unpublished data). It should be noted that 70% is only an average and that any one area may have more or less available habitat; therefore, each area needs to be evaluated independently. There is really no way of knowing the magnitude of actual bat habitat and animal loss from past closures of abandoned mines. It is imperative that scientists err on the side of caution and that competent surveys and

identification of bat resources precede further attempts to use permanent closure techniques not conducive to providing continued access to bats. New, more cost effective survey methods, such as using short- and long-wave infra-red video cameras, are making surveys easier and may be incorporated into protocols to help facilitate this recommendation. For abandoned mines that are scheduled to be closed, after appropriate surveys and exclusions are conducted, it is best to immediately close the mine or at least install temporary exclosures to make sure that bats do not re-enter the mine. Bird netting with 1 inch mesh is suitable material to use for temporarily closing a site, provided that the netting is pulled tight so that bats are able to leave the roost. Plastic netting used by mining companies can also be used, but they must be maintained often as woodrats easily chew through them. This plastic netting material may represent a hazard to snakes and birds. Chicken wire is also an effective material, but it can be very difficult to work with. In winter, bats have been observed crawling through one inch nets to enter a mine for hibernation (P. E. Brown, personal communication).

Ideally, it is best to conduct a four-season survey of each site scheduled for possible closure. A recent study of roost fidelity in Townsend's big-eared bat, *Corynorhinus townsendii*, found that it took on average, 3-8 complete internal surveys of an abandoned mine before all bats were detected or the mine was determined not to house bats (Sherwin et al., 2000b). Specifically, it took an average of 8.3 surveys before a given mine could be eliminated as an actual roost, 3.4 surveys to detect maternity roosts, and 7.6 surveys to eliminate a given site as a hibernacula (Sherwin et al., 2000b). This same study also found that even species considered relatively sedentary in their roost movements actually move between roosts fairly frequently in mines. Given these data, it would be prudent to err on the side of caution and do multi-seasonal surveys, and even longer term surveys if possible. However, given limited resources and time, this is not always practical. A two season survey, one in the summer and one in the winter, would capture the two most critical roosting periods for bats, namely the maternity season and the hibernation season. These type of surveys may miss bats using sites for night roosts and for critical staging areas for migration, courtship, and mating. Within the constraints of funding, time, and other limiting factors, partners should strive to incorporate at least two season surveys if not four seasons, recognizing that this is not always possible. Often the amount of guano inside a mine can be indicative of the amount of use for summer colonies and for staging areas. However, the amount of guano is not indicative of winter use. Many species, such as *Myotis ciliolabrum*, utilize very small cracks and crevices during winter hibernation and are very easy to overlook during a winter survey. Therefore it is critical not to permanently close a mine during the winter. Any type of closure, permanent or bat-friendly, should be conducted during early spring or late fall whenever possible, as these are the times of the year when roosting bats are least susceptible to disturbance. Complexity of sites, seasonal use specific to the area, and other contributing factors will affect the proper course of action and each site needs to be evaluated on its own merits.

Internal surveys are not always possible due to safety reasons. Ideally, if a mine is safe enough to conduct an internal survey, it is best to couple this survey with an external survey during the outflight. It is possible to miss bat signs while doing an internal survey and simultaneously conducting an exit count in the early evening of the site will provide added evidence for either the presence or absence of bats.

Survey protocols are provided for general guidance only (Appendix A). Each complex of mine shafts and adits offer unique circumstances that may require some revisions in a survey protocol in order to provide the best possible information. Different species of bats use mines in different ways, complicating this issue. Each mine should be evaluated within the confines of established survey protocols to the extent possible, recognizing that modifications and/or additional surveys may be necessary.

Once adequate surveys have been conducted, the question then becomes which adits and shafts should remain open, how to protect them, and what constitutes significant bat use to justify these decisions. These questions are difficult to answer on a statewide basis as each site may require a different approach. Once bat use has been documented, then a closure plan and a landscape plan can be initiated. These plans will vary depending on the requirements of the managing agency, the complexity of the site, the amount of usage and the seasons in which bats are present, as well as the individual

biological needs of the species of bats present. Appendix A provides a general guideline and flowchart to assist land managers in evaluating projects and determining impacts to bats and their habitats.

Opportunities For Conservation

Gating and/or temporary use restrictions of caves and adits can provide security for bat populations during critical life history stages**.** Bat gates should be of proper design and strength to discourage vandals and should be appropriate for the target species as well as the characteristics of the mine. When choosing an appropriate gate, consultation with knowledgeable individuals is invaluable.

In some areas, due to expense, access issues, or engineering considerations of the mine, bat gates may not be possible. An Attorney General's opinion (Del Papa and Taylor 1994; see Appendix B for full text) provides some protection from state liability for sites which have been fenced and signed according to State specifications. Where permanent closure or bat gating is not possible, fencing is a viable option to gating or permanent closures.

Arbitrary placement of fencing material directly over an adit or shaft entrance can have deleterious impacts to resident bats. Fencing should be set back as appropriate from the structure entrance (BLM Final Programmatic EA, 2000). Appropriate fencing is less expensive and may be a preferred closure alternative over gating for some colonial *Myotis* species where vandalism and human safety issues are not chronic problems (Ludlow and Gore, 2000). Also, in some instances of large open cuts and stopes where traditional bat gates cannot be used, fencing with proper signage may be the only alternative to any permanent closure method.

An opportunity exists to mitigate permanent loss of bat roost habitats in some mines (Sherwin and Altenbach, 2003). Once a mining plan of operations has identified a series of historical adits and shafts that will be destroyed with open-pit activities, the historical workings would preferably be surveyed for four seasons to determine bat activity. If significant roosting habitat is found within the site, alternate roosting locations with similar and suitable internal microclimates can be sought nearby and secured as alternate habitat. Bats often utilize different structures for winter and non-winter roosting, so more than one mitigation site may be necessary. To the extent possible, placement of mitigation sites should take into account the long range forecast of the mine's plan of operations to avoid locating mitigation sites within the sphere of potential mine expansion.

A recommended certification process for scientists capturing and handling bats in Nevada is outlined under Proposed Scientific Collection Permit Changes in Appendix B. It is the recommendation of this plan to have the certification process codified in Nevada Sate Law and tied to the Scientific Collection Permit process. Survey and inventory work that does not involve capturing and handling of bats should be conducted under the guidance of a knowledgeable biologist who is experienced with bats.

Priority Bat Species

Primary Conservation Strategy

Townsend's big-eared bat
pallid bat
Allen's big-eared bat
California leaf-nosed bat
California myotis
western small-footed Myotis
fringed myotis
cave myotis
Yuma myotis
Brazilian free-tailed bat

big brown bat
long-eared myotis
little brown bat
silver-haired bat
long-legged myotis
western pipistrelle
spotted bat
Mexican long-tongued bat
big free-tailed bat

CONSERVATION STRATEGY: NATURAL CAVES AND MINE SHAFTS AND ADITS

OBJECTIVE – Maintain stable or increasing populations of cave and mine roosting bats in Nevada through 2015.

Strategy: *Initiate research and monitoring activities to provide information on life history, population status and trend, location of key concentrations, and conservation needs of cave and mine roosting bats.*

Action: Identify and map key hibernation, maternity, bachelor, staging, leking and/or night roost sites in caves and mine shafts and adits that either currently support or have historically supported populations of bats. Identify and survey potential sites with suitable features for roosting to document the comprehensive distribution of cave and mine roosting bats.

Action: Conduct routine and systematic surveys of key sites to document long-term population trends, types of use, size of population, etc. A variety of techniques could be employed to accomplish this task, including acoustic monitoring, internal surveys, external monitoring, and capturing individual bats.

Action: Initiate research projects that explore the ecology, associated habitat use, and seasonal movement patterns of Townsend's big-eared bat, pallid bat, Allen's big-eared bat, California leaf-nosed bat, California myotis, western small-footed myotis, fringed myotis, Yuma myotis, Mexican long-tongued bat, big brown bat, and Brazilian free-tailed bat. When surveying thermal caves and mines, target pallid bats statewide and California leaf-nosed bats when in southern Nevada. For Townsend's big-eared bat, conduct statewide surveys and monitoring in all caves and mines, and place particular emphasis on cave habitats in six areas – the Snake Range, Schell Creek Range, White Pine Range, Kern Mountains, Goshute Range, and Spruce Mountain.

Action: Document the importance of caves and mines to the roosting ecology of long-eared myotis, little brown bat, silver-haired bat, long-legged myotis, western pipistrelle, spotted bat, and big free-tailed bat, paying particular attention to hibernacula sites for silver-haired bats and spotted bats. Document the type of use, whether it be as hibernacula, maternity, bachelor, staging, leking or night roosting.

Action: Initiate research studies to document the characteristics of natural caves and mines shafts and adits that provide suitable roosting habitat for bats. Incorporate this information into systematic surveys and routine monitoring of both known and potential roosting sites.

Action: Initiate research studies to document suitable microclimates of key hibernation and maternity sites, understanding that ideal characteristics will vary by species, by latitude, and by specific landscape features in the area. For example, one of the largest and most consistent hibernation roosts of Townsend's big-eared bats known in the state is an extremely complex abandoned mine adit/shaft system, with a large volume of air flow, and internal midwinter temperatures that hover near freezing (28-35°F) regardless of outside ambient air temperatures. While other abandoned mine structures with similar characteristics may serve as hosts to important roosts for this and some additional species, other species have substantially different hibernacula requirements. It is important to recognize that focusing on one set of parameters for hibernacula recognition and protection is not appropriate for all species.

Action: Where it does not conflict with specific research requiring other methods, conduct annual or biennial monitoring of key maternity sites and triennial monitoring of key hibernation sites through the implementation of multi-agency coordinated monitoring plans specifically designed to minimize disturbance and eliminate duplication of effort.

Action: Conduct research to determine the effects of natural and non-natural fires to cave and mine roosting bats, particularly for Townsend's big-eared bat which have been shown to rely heavily upon adjacent wooded areas for foraging.

Strategy: *Conserve important bat roosting sites in natural caves, mine shafts and adits throughout the state.*

Action: Conserve and protect sites exhibiting substantial use by cave and mine roosting bats. Conservation should focus on the suite of roosts used by bats within their ecological neighborhood (including boulder fields, day roosts, night roosts, and foraging/water areas). Site-specific peak activity periods may vary based on latitude and elevation. Depending on the site, a mix of strategies may be employed including: gating, education, law enforcement and road/trail closures.

Action: Whether they are abandoned, active, on public and/or private, or on patented lands, where public funds are being expended, hard rock mines destined for closure activities should receive proper evaluation as bat habitat prior to closure (Appendix A).

Action: Hazard signs and fencing of mine adits and shafts are interim securing alternatives to permanent closure. Ideally, at mine sites with substantial use by bats, permanent bat gates should be installed, but in the absence of such actions due to lack of funding, unfavorable site characteristics, etc., fencing may be an appropriate alternative. Each site should be evaluated on its own merit as to the appropriate course of action.

Action: If appropriate biological surveys of a mine site reveal no significant use by bats, and as long as any and all bats are excluded properly prior to closures, in the absence of other limiting factors, permanent closure by backfilling or foaming may be appropriate methods to secure the abandoned mine for human safety reasons.

Action: Work with private landowners and local entities where appropriate to protect cave and mine roosting bats. Some appropriate courses of action may include pursuing conservation easements, gating, or temporary closures at a site during critical times of the year.

Action: Caves of substantial size and with substantial numbers of bats should be addressed by working with local grottos and other users and appropriate Federal and State agencies to

secure protection. Alternatives may include installation of bat gates, restricting access during key periods of the year, and educating recreational cavers.

Action: Interact with local grottos to encourage: a) confidentiality of caves used by bats; and, b) support of bat conservation efforts.

Action: For sites with substantial bat use, develop coordinated protection plans with local entities and responsible parties.

Action: Where protection of key cave or mine roosting sites is not an option, explore mitigation possibilities such as designing and constructing alternate roost sites.

Action: Evaluate regional and local fire plans for their impacts to bats and provide expert input into such plans to adequately provide protection for important colonies of bats.

Strategy: *When compared to the other species found in the state, the Brazilian free-tailed bat roosts in exceptionally large colonies in caves. Conserve these large roosts where they occur.*

Action: Specific attention should be given to the monitoring and protection of these large roosts known in the State as well as the identification of new sites, with emphasis on surveys of caverns with large openings.

Action: Search limestone mountain ranges in eastern Nevada for large cavern openings and follow up with surveys for potential maternity/bachelor roosts from June to October.

Action: Continue long-term population monitoring of Rose Cave in White Pine County.

Action: Continue to monitor microclimate characteristics of Rose Cave following site rehabilitation.

Action: Maintain interpretative signs at Rose Cave site.

Action: Initiate and maintain road closure at Rose Cave site.

Action: Changes in the relative abundance or gender ratio should be monitored and managed appropriately at Rose Cave. Historical records suggest maternity activity, but recent surveys have documented only males and non-reproductive females. Continue to monitor gender and age ratios at Rose Cave on a triennial basis.

Strategy: *Create and implement an education program for the conservation of cave and mine roosting bats*.

Action: It is Federal (BLM) and State (Division of Minerals) policy to discourage entry of AML features except by trained, properly equipped, qualified professionals with a valid reason for entry. Continue to educate individuals and promote this policy.

Action: Educate landowners and managers regarding the effects of management activities on local bat populations through workshops, brochures, and training.

Action: Develop and distribute conservation education material to improve public awareness and stewardship of bats using caves and mines.

Action: Explore partnerships with educators and land managers to encourage the addition of bat conservation topics into existing campaigns and projects. One such example would

be to couple the “Stay Out Stay Alive” campaign with the conservation needs of bats.

Assumptions - Research and Monitoring Needs

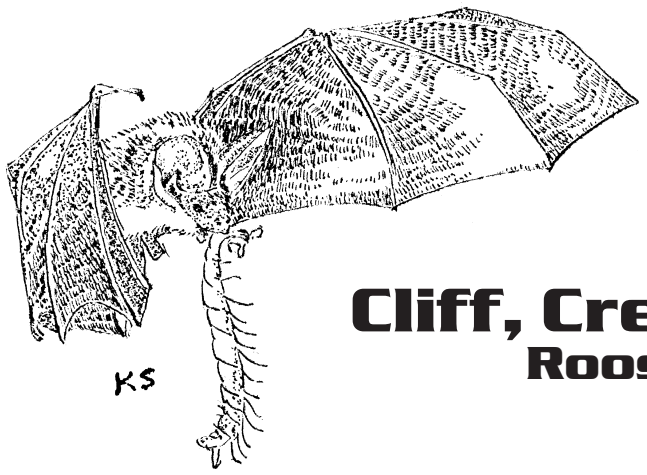
Much information is lacking on basic population status and trend for many species that utilize caves and mines. For example, pallid bats and Townsend’s big-eared bats are often found in abandoned mines, yet their status and trend are not well documented. Comparative baseline data are lacking, therefore making it impossible to determine the trend of species across time and space. Additionally, there is still much to learn about roosting requirements of bats that use mines and caves. For example, big brown bats are found throughout most of North America and appear to be common over much of their range. Although many records occur in Nevada, little is known about the roost sites and seasonal habits of this species. Historical records of California myotis indicate widespread use of abandoned mines, but always in low numbers. However, individual movement patterns between seasons, specific roost requirements, and frequency of roost shifting is unknown and is critical to properly conserve and manage this species in the mine and cave resources it utilizes.

For some species that primarily use other habitat guilds for day roosting and breeding sites such as spotted bats, big brown bats, silver-haired bats, and long-legged myotis, caves and mines are reported to be important as winter hibernacula. Most cave and mine observations of spotted bats and silver-haired bats have occurred during hibernation periods. Additional documentation is necessary to determine how some species dependence upon caves and mines changes seasonally. There is also evidence that suggests caves and mines may not only be used as roost sites but also as foraging sites, particularly for the long-eared myotis. This type of suspected use needs further study.

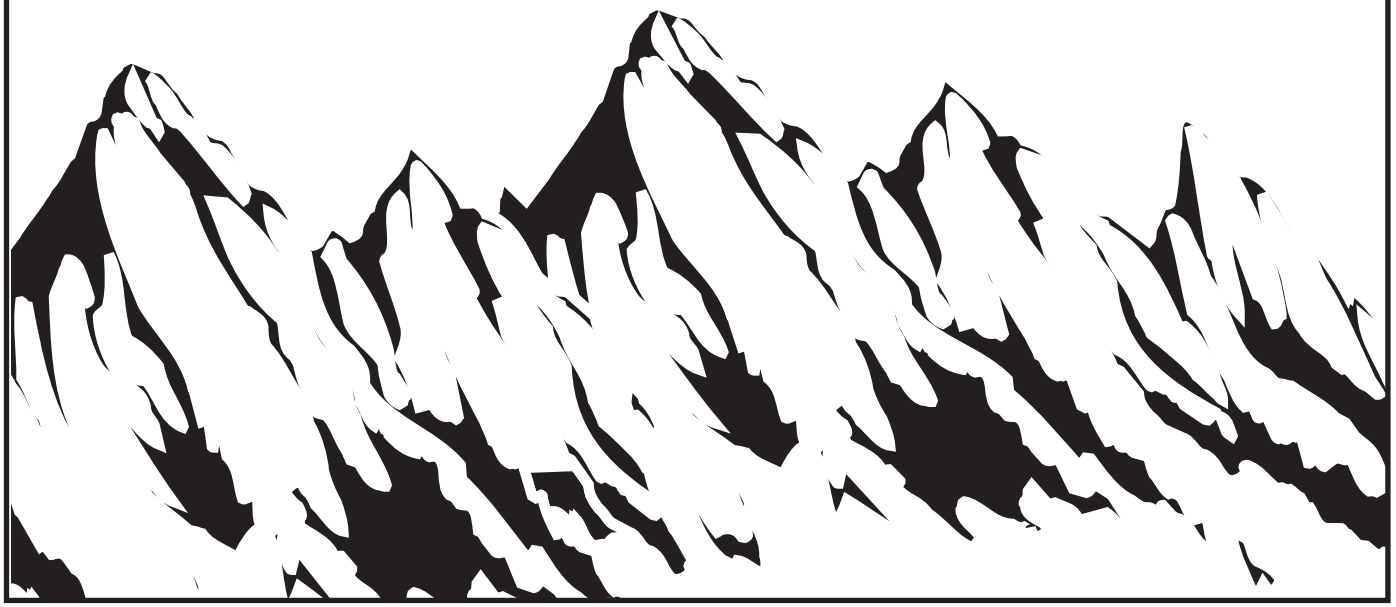
Some species of bats are cave or mine roosting obligates. For at least one of these species, the California leaf-nosed bat, it is known that it requires warm temperatures for roosting in the winter and therefore geothermally heated mines and caves can be targeted for surveys and, if appropriate, conservation sites. For other species, specific microclimate needs and preferences within a given cave are unknown and need to be examined.

Delineating winter hibernacula can be challenging, yet is critical to the conservation of bats. Winter hibernacula may be a limiting factor in the distribution of some species, particularly those that require very specific microclimates. The characteristics and preferences of various species need to be researched and documented. A substantial sized hibernating group of western small-footed Myotis found in a deep, complex abandoned mine in eastern Nevada suggest winter congregations may occur in other such structures, yet this has been relatively undocumented. Because many species of bats hibernate in groups, such congregations may place a large proportion of the population at risk from a single disruptive event. Also, these roosts can be several hundred meters underground with the only access being a vertical shaft, making the roosts extremely difficult to survey and monitor.

It is recommended that bat gates be installed to protect key colonies of bats. For some species, such as Allen’s big-eared bat, California myotis, and the long-legged myotis, more information is needed on their use and acceptance of bat gates. The type of gate installed may be important and it is critical to explore potential variation in the acceptance of different gate designs among and between species. Follow-up monitoring of all colonies after gating should be considered a priority.



Cliff, Crevice and Talus
Roosting Habitat










CLIFF, CREVICE AND TALUS ROOSTING HABITAT (CL)

General Distribution

Cliff, crevice and talus roosting habitat is found throughout Nevada in most rock types. Igneous (basalt, granite), metamorphic (quartzite and marble), and sedimentary (limestone and sandstone) deposits are common throughout the State and often provide suitable roosting habitat. Those areas where geologic activity is most recent, such as lava flows, glaciation and faulting, provide some of the more suitable cliff, crevice and talus roosting habitats.

Compared to the total land area available, cliff, crevice and talus roosting habitats comprise a small fraction of Nevada's total land area.

Physical Characteristics

Cliff, crevice and talus roosting habitats range in elevation from 150 m along the lower Colorado River to over 4,000 m on Boundary Peak and Wheeler Peak. Precipitation varies accordingly from less than 10 cm in the south to over 80 cm on the higher mountains of the north and can come in the form of rain or snow anywhere in the State. Soil types range across the spectrum from fine clays to coarse gravels.

Cliff, crevice and talus roosting habitats are extremely variable but rather simple in nature. Cliffs can be as short as 6 m or as tall as 900 m. Talus slopes can be less than a hectare to several hundred hectares in size and are often the result of mass wasting processes associated with cliff habitats. Generally, cliffs, crevices and talus slopes provide suitable maternity and night roosting habitat in summer. In northern Nevada, these sites are typically too exposed to provide significant hibernation roost sites. However, there is evidence that rock crevices provide wintering habitat in the Mojave Desert portion of southern Nevada. Crevices in relatively small rocks and boulders may also be used.

Dominant Plant Species

Plant species composition varies with elevation, precipitation, latitude and longitude and incorporates the range of plant assemblages found in Nevada.

Historical and Current Condition

Recreational rock climbing has increased dramatically over the past 30 years, with southern Nevada receiving the highest recreational climbing levels in the state. Increased human disturbance is expected to have altered some cliff and crevice habitats, yet little research has been conducted to determine to what degree climbing activities may have an effect on cliff roosting bats. Climbing routes in Meadow Valley Wash have been documented occurring at the exact locations where some crevice roosting species form maternity colonies, and this dual occurrence is sure to exist in areas of Red Rock Canyon National Conservation Areas as well (J. A. Williams, personal communication).

Talus habitats, particularly those nearer metropolitan areas, have been the focus of increased activity by rock extraction industries.

Opportunities for Conservation

Where recreational climbing and cliff and crevice roosting habitats coincide, there may exist opportunities to manage climbing through temporal or spatial restrictions to provide adequate security for bat populations. Partnerships with climbing groups may be formed to provide biologists with locations of roosting bats and potential applied research opportunities.

Priority Bat Species

Primary Conservation Strategy

spotted bat
pallid bat
western mastiff bat
western pipistrelle
big free-tailed bat
Brazilian free-tailed bat

Secondary Conservation Strategy

Townsend's big-eared bat
big brown bat
long-legged myotis
silver-haired bat
California myotis
western small-footed Myotis
long-eared myotis
little brown bat
fringed myotis
Yuma myotis

CONSERVATION STRATEGY: CLIFFS, CREVICES, AND TALUS

OBJECTIVE – Maintain stable or increasing populations of cliff, crevice, and talus roosting bats in Nevada through 2015.

Strategy: *Initiate research and monitoring activities to provide information on life history, population status and trend, location of key concentrations, and conservation needs of cliff, crevice and talus roosting bats.*

Action: Identify and map key hibernation, maternity, bachelor, staging, leking and/or night roost sites in cliffs and talus that either currently support or have historically supported populations of bats. Identify and survey potential sites with suitable features for roosting to document the comprehensive distribution of cliff and talus roosting bats.

Action: Incorporate radio-telemetry and acoustic studies to locate key cliff and talus use areas. Document bat use, including number and location of roosts, roost fidelity, frequency of changes in roost occupancy, and associated foraging requirements to better understand bat use of cliff, crevice and talus areas and use this information to design practical conservation strategies.

Action: Conduct routine and systematic surveys of key sites to document long-term population trends, types of use, size of population, etc. A variety of techniques could be employed to accomplish this task, including acoustic monitoring, outflight counts, and capturing individual bats.

Action: Initiate research projects that explore the ecology, associated habitat use, and seasonal movement patterns of spotted bat, pallid bat, western mastiff bat, western pipistrelle, big free-tailed bat, and Brazilian free-tailed bat.

Action: Document the importance of cliffs and taluses to the roosting ecology of Townsend's big-eared bat, big brown bats, long-legged myotis, silver-haired bat, California myotis, western small-footed Myotis, long-eared myotis, little brown bat, fringed myotis, and Yuma myotis.

Action: Initiate research studies to document the characteristics of cliffs and taluses that provide suitable roosting habitat for bats. Incorporate this information into systematic surveys and routine monitoring of both known and potential roosting sites.

Action: Initiate research studies to document suitable microclimates of key hibernation and maternity sites, understanding that ideal characteristics will vary from species to species. Once these characteristics have been delineated, conserve and monitor sites that have a suitable microclimate.

Action: Initiate research projects to study the impacts of recreation on local bat populations. Document the incidences, or lack thereof, of disturbance by recreational climbers and their potential or realized impacts to cliff roosting species.

Action: Where appropriate, conduct annual or biennial monitoring of key maternity sites and triennial monitoring of key hibernation sites through the implementation of multi-agency coordinated monitoring plans specifically designed to minimize disturbance and eliminate duplication of effort.

Strategy: *Conserve important bat roosting sites in cliffs, crevices, and talus habitat throughout the state*.

Action: Conserve and protect sites exhibiting substantial use by cliff and talus roosting bats. Conservation should focus on the suite of roosts used by bats within their ecological neighborhood (including boulder fields, day roosts, night roosts, and foraging/water areas). Site-specific peak activity periods may vary based on latitude and elevation. Depending on the site, a mix of strategies may be employed including: minimizing human disturbance around key sites, education, law enforcement and road/trail closures.

Action: Work with private landowners and local entities where appropriate to protect cliff and talus roosting bats. Some appropriate courses of action might include pursuing conservation easements, and/or temporarily closing a site during critical times of the year.

Action: In areas with substantial bat use of cliffs and talus habitats, work with local recreational users and appropriate Federal and State agencies to secure protection. Protection strategies could include temporarily closing sites during key times of the year, educating recreational climbers, and/or pursuing special land designations such as "Areas of Critical Environmental Concern", "Research Natural Area", "Natural Resource Area", etc.

Action: Interact with recreational climbers to encourage: a) confidentiality of cliff and crevice roosts used by bats; b) support of bat conservation efforts; and, c) support of possible temporary route closures for seasonal roost protection in critical areas.

Action: For sites with substantial bat use, develop coordinated protection plans with local entities and responsible parties.

Action: Where protection of key cliff and talus roosting sites is not an option, explore mitigation possibilities such as designing and constructing alternate roost sites.

Action: Evaluate proposals for rock extraction activities for their impacts to bats and provide expert input into such plans to adequately provide protection for substantially sized colonies of bats.

Strategy: *Create and implement an education program for the conservation of cliff, crevice and talus roosting bats.*

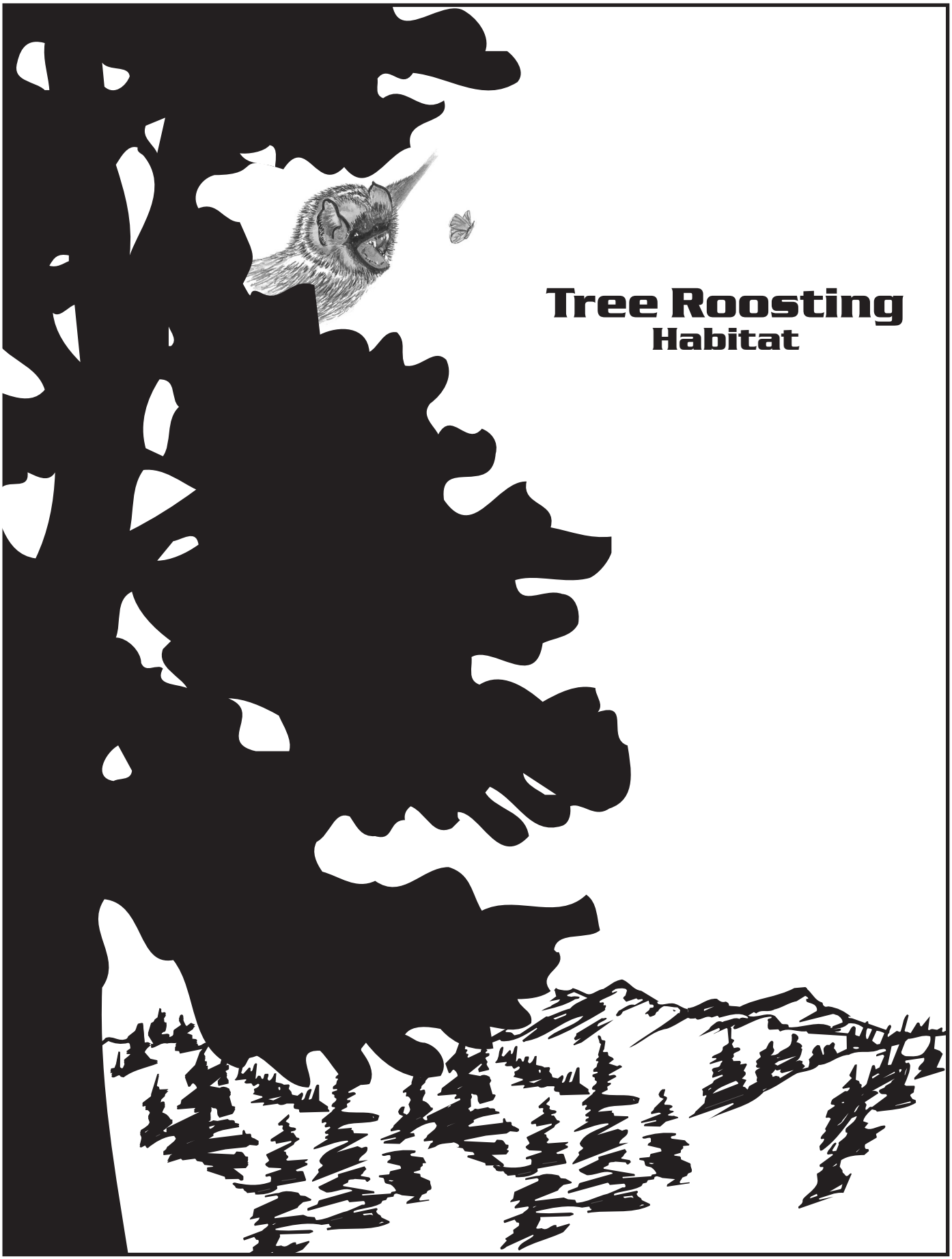
Action: Educate landowners and managers regarding the effects of management activities on local bat populations through workshops, brochures, and training.

Action: Develop and distribute conservation education material to improve public awareness and stewardship of bats using cliffs, crevices and talus slopes.

Action: Explore partnerships with other educators, land managers, and recreational groups to encourage the addition of bat conservation initiatives into existing and/or new campaigns and projects.

Assumptions - Research and Monitoring Needs

Cliff, crevice, and talus roosting bats are very difficult to study and survey, and therefore very little is currently known about roosting requirements, microhabitat preferences, and general distribution of these bats. Virtually nothing is known about what portion of the population uses such roosts or any of the physical characteristics required for such a roost. Individuals may frequently move from roost to roost throughout the year but nothing is known of this dynamic. For example, we know that spotted bats are highly associated with prominent rock features and are dependent on rock-faced cliff roosting habitat, yet there is a complete lack of specific cliff and talus roosting information for spotted bats in Nevada. Pallid bats are known to use boulders as roosting sites, including maternity sites, yet what constitutes good habitat and the location of these sites are unknown. Radio-telemetry studies may help to provide this critical information. For some species, such as silver-haired bats, which primarily roost in other types of habitats, cliffs and talus slopes may be important as winter refugia, especially in the Mojave Desert. The most well-known roosts for Brazilian free-tailed bats in Nevada occur in caves and bridges. However, cliff and crevice roosting habitats may hold important segments of the population during portions of the year. There is a great need to understand this roosting habitat. In Colorado, big brown bats were radio-tracked during the autumn to rock crevices in cliffs and presumed to hibernate there (Neubaum, 2005). Most known summer roosts of big brown bats are in other habitat types, but cliff, crevice, and talus roosting habitat may be critical for winter hibernation. For other species, such as the long-eared myotis and the long-legged myotis, their use and reliance on cliff, crevice and talus habitat is unknown and requires further research.



Tree Roosting
Habitat








TREE ROOSTING HABITAT (TR)

General Distribution

Tree roosting habitat is found throughout the State in two primary locations: riparian areas across all elevations and mountain/valley regions above 1,500 m. Riparian woodland areas that offer suitable roosting habitat for bats are found at elevations as low as 150 m along the Colorado River, to 3,000 m or more at springs and in mountainous regions.

Riparian woodland areas

Riparian woodland habitat in Nevada is associated with major river systems, streams, springs, or seeps occurring primarily below 3,000 m in the state. While there are an estimated 15,470 springs or seeps known in Nevada (M. O'Brian, personal communication; Geographic Names Information System), there are only five primary river systems: the Humboldt, Truckee, Carson, Walker, and Colorado Rivers and their tributaries. Total riparian habitat in Nevada is estimated at 110,800 hectares (ha; Nevada GAP Analysis, 1996). Woodland riparian habitat accounts for only a small fraction of the total riparian habitat available.

Dominant woody plant species in riparian woodland habitat includes cottonwoods (*Populus fremontii, P. angustifolia*), willows (*Salix* spp), water birch (*Betula occidentalis*), thinleaf alder (*Alnus tenuifolia*) and buffaloberry (*Shepherdia argentea*). Additionally, in southern Nevada velvet ash (*Fraxinus velutina*), desert willow (*Chilopsis linearis*), seep willow (*Baccharis salicifolia*) and mesquite (*Prosopis glandulosa and P. pubescens*) are also common plants in desert washes and riparian habitat. A number of bat species, including the Lasiurines, are known to roost in cottonwoods and palm trees. Observations of bats roosting in other riparian tree species in the State are lacking due to insufficient surveys.

Non-native California fan palms (*Washingtonia filifera*) occur along the Muddy River, and today exist primarily at the headwaters in the upper Moapa Valley and as ornamental landscaping plants in urban areas. This habitat provides the only known roosting location in the state for western yellow bats (*Lasiurus xanthinus*). However, additional research is expected to identify western yellow bats roosting secondarily in other riparian woodland species. For example, recent acoustic surveys along the Las Vegas Wash has regularly documented western yellow bats. Tamarisk (*Tamarix ramosissima*) is an aggressive exotic tree found in Nevada's river systems throughout the entire state. Hoary bats have been documented roosting in tamarisk stands in the Las Vegas Wash (J. A. Williams, personal communication) and in Palo Verde (P. E. Brown, personal communication). Russian olive (*Elaeagnus angustifolia*) is another successful exotic tree that has invaded the riparian communities of Nevada, and is most prevalent in the Great Basin.

Upland woodland areas

Mountain and valley regions above 1,500 m in the State are inhabited by a variety of tree species that provide roosting resources for bats. Dominant species include Joshua tree (*Yucca brevifolia*), singleleaf pinyon pine (*Pinus monophylla*), juniper spp. (*Juniperus osteosperma and J. scopulorum*) and mountain mahogany (*Cercocarpus ledifolius*) on more xeric sites from 1,500 to 3,000 m. More mesic, higher elevation sites are dominated by larger pines (*Pinus longaeva, P. flexilis, P. ponderosa, P. jefferyi, P. albicaulis*), fir (*Abies concolor, A. lasiocarpa, Pseudotsuga menziesii*) and spruce (*Picea englemannii*) from 1,500 m to tree line. In the Great Basin, aspen (*Populus tremuloides*) is found in patches between 1,800 m and 3,000 m, primarily where soil moisture is favorable. Bats are known to roost in singleleaf pinyon pine, juniper, and various large pine species. Observations of bats roosting in aspen in Nevada are limited. However, it is suspected that exfoliating bark is a significant roost habitat for some species. Further study is needed.

Historical and Current Condition

Riparian areas are among the most disturbed habitats in the southwestern U.S.. Two decades ago, Swift (1984) estimated that riparian habitats have been reduced by more than 80% in the arid west and mid-west. Cottonwood trees alone are estimated to have been reduced 70-95% from their historical distributions only a century ago (Braatne et al., 1996). Riparian areas are extremely susceptible to anthropogenic disturbances, including water impoundments, urban and agricultural development, recreation, and livestock grazing.

Forested upland habitats above 1,500 m in the State are in varying degrees of health. Fire suppression, livestock grazing, exotic plant and animal introductions and historical mining practices, including the destruction of tens of thousands of hectares for charcoal production, have contributed to the current landscape condition.

Fire regimes should be restored to their proper historical level, taking into consideration the needs of nearby roosting bats. In some cases, fire may have deleterious impacts to local populations of bats. If timed poorly, smoke from a fire could kill substantial numbers of bats. A large fire may cause a substantial portion of a foraging habitat adjacent to a maternity roost to become unusable to forest gleaning species and may cause tree-roosting species to lose roost sites.

Opportunities for Conservation

Where riparian areas occur, opportunities to manage or curtail disturbance should be considered. The popularity of these habitats in combination with their fragile state should be accounted for in conservation management planning efforts. Where historical riparian areas no longer exist, management efforts should be initiated to restore habitats or mitigate for their loss.

In forested uplands, management techniques should be altered to accommodate appropriate fire and timber management techniques, limitation of livestock grazing, and control and management of exotic species introductions. Restoration projects should emphasize management towards healthy woodland communities with a goal of restoring woodlands in Nevada to their historic distribution and abundance on the landscape. Forest plans should address bat habitat conservation (e.g. old growth, snags per acre, foraging habitat, bat diversity, etc.).

Priority Bat Species

Primary Conservation Strategy

silver-haired bat
western red bat
hoary bat
western yellow bat
big brown bat
Allen's big-eared bat
California myotis
western small-footed Myotis
long-eared myotis
little brown bat
fringed myotis
long-legged myotis

Secondary Conservation Strategy

pallid bat

Townsend's big-eared bat
Yuma myotis
Brazilian free-tailed bat

CONSERVATION STRATEGY: TREE ROOSTING HABITAT

OBJECTIVE – Maintain stable or increasing populations of woodland/forest bats that roost in tree foliage, snags or exfoliating bark throughout their range in Nevada through 2015.

Strategy: *Initiate research and monitoring to provide information on life history, population status and trends, location of key concentrations and conservation needs of woodland/forest bats using tree foliage, snags and exfoliating bark.*

Action: Identify and map key woodland/forest and riparian areas with concentrations of roosting bats. Identify woodland/forest and riparian areas with suitable features for bat roosting, and initiate surveys of likely sites to delineate the comprehensive distribution of tree roosting bats.

Action: Incorporate radio-telemetry and acoustic studies to locate key woodland/forest and riparian use areas. Document bat use, including number and location of roosts, roost fidelity, frequency of changes in roost occupancy, and associated foraging requirements to better understand bat use of woodland/forest stands and riparian areas and use to design practical conservation strategies.

Action: Identify the features of snags and woodland/forest and riparian stands that provide preferred bat roosting habitat for silver-haired bat, western red bat, hoary bat, western yellow bat, big brown bat, Allen's big-eared bat, California myotis, western small-footed Myotis, long-eared myotis, little brown bat, fringed myotis, and long-legged myotis (e.g. snags, tree species, age of timber stand, leaf litter, etc.).

Action: Document the importance of snags in woodland/forest and riparian habitats to the life history of Townsend's big-eared bat, pallid bat, Yuma myotis, and Brazilian free-tailed bat in Nevada.

Action: Conduct regular monitoring of key maternity and hibernation sites through the implementation of multi-agency coordinated monitoring plans to better understand the tree roosting requirements of bats in the State.

Action: Conduct routine and systematic bat surveys in likely habitat to inventory and document long-term population trends.

Strategy: *Conserve important roosting populations of woodland/forest and riparian bats.*

Action: Conserve and protect sites exhibiting substantial use by tree roosting bats. Conservation should focus on the suite of roosts used by bats within their ecological neighborhood (including day roosts, night roosts, and foraging/water areas). Site-specific peak activity periods may vary based on latitude and elevation.

Action: Identify historical locations of cottonwood galleries within current and historical riparian areas of Nevada's water sources and historical locations and conditions of woodland/forest habitats in Nevada.

Action: Promote the re-establishment and conservation management of cottonwood trees in riparian areas where cottonwood has been extirpated in Nevada, while demonstrating the importance of existing and potential cottonwood galleries in Nevada's riparian habitats. Protect existing stands of cottonwood trees from overgrazing, gravel mining, urbanization, and other non-natural deleterious threats.

Action: Document the importance of different seral stages of forest types for tree roosting bats and manage for the long-term maintenance of these resources. The importance of older seral stage living trees and the different decay classes of snags should be identified. Conservation of the important tree roosting resources bats require should be incorporated into forest management practices.

Action: Design and implement stand restoration projects that provide for the needs of roosting bats and incorporate these projects into land management planning efforts, particularly forest management plans, timber harvest plans, and riparian restoration plans.

Action: Evaluate land use and habitat modification projects in woodlands/forests for impacts to roosting bats. Provide expert input into the project design to ensure that bat habitat requirements are met. When unavoidable impacts occur within the project design, whenever possible, mitigate impacts by ensuring the availability of suitable roosting resources nearby.

Action: Design and implement conservation plans to maintain suitable roosting habitat in woodland/forest and riparian areas.

Action: Include known locations of important roost sites in regional fire prevention plans for consideration in fire management practices.

Action: Western yellow bats roost in California fan palms (*Washingtonia filifera*) in southern Nevada. The extent of these stands needs to be delineated. In sites where no or a negotiable conflict exists with critical habitat management of the endangered Moapa Dace (*Moapa coriacea*), incorporate remaining western yellow bat roost sites into land management-planning efforts, particularly riparian restoration plans. In such areas, achieve and maintain good to excellent condition of dead palm fronds. Continue to survey other areas with established California fan palms to document new occurrences of western yellow bats.

Strategy: *Create and implement an education program featuring the conservation of woodland/forest roosting bats.*

Action: Educate landowners and managers regarding the effects of management activities on bat populations through workshops, bulletins, and training.

Action: Develop a Position Statement from the Nevada Bat Working Group that outlines preferred roosting and foraging habitat for woodland/forest roosting species. The position statement would be provided to land-use agencies when comments to forest harvest plans are solicited.

Assumptions - Research and Monitoring Needs

The nature and extent of the use of trees for roosting is not well-documented in Nevada for any tree roosting bat including pallid bat, Townsend's big-eared bat, big brown bat, California myotis, western small-footed Myotis, little brown bat, fringed myotis, long-legged myotis, and Yuma myotis although several of these species have been well-studied in woodland habitats in other areas such as in Arizona and British Columbia. In California, Townsend's big-eared bats are known to roost in large trees that provide cave-like conditions. It is assumed that trees, particularly those on the eastern front of the Sierra Nevada and subalpine coniferous forests of the Great Basin may provide similar habitats in Nevada. Further research is necessary.

Data suggest a substantial decline in western red bat population levels throughout its range. This species has been encountered in recent sampling efforts with less frequency than it was historically. This is especially alarming considering researchers have much more efficient methods of sampling bats currently then historically. Although multiple factors are suspected, the drastic decline of cottonwood tree galleries in the western U.S is considered the prime factor affecting this obligate tree-roosting species. Recent acoustic surveys have increased the known distribution of the western red bat in Nevada. Although this species was thought to be a short-term seasonal migrant for the state, preliminary evidence indicates some protracted use throughout the summer months. The importance of leaf litter as roosting habitat is suggested from work conducted on the Eastern Red Bat.

Throughout its range, there is very little known about the roosting requirements of the western yellow bat. In southern Nevada, as well as other parts of its range, this species is known to heavily prefer roosting in the dead leaf skirts of palm trees. In Texas it has been observed roosting in the dead leaf skirts of yucca foliage. Within palm groves, research suggests that this species prefers exceptionally dense stands of palm tree groves. Future research should target identifying macro- and micro-roosting habitat requirements.

Allen's big-eared bat is found only in southern Nevada from a few locations with most being concentrated in the southern portion of the Spring Mountains in Clark County. Throughout its range, the distribution appears patchy. The species appears to breed in coniferous forest and winter at lower elevations. Two populations have been found breeding at low elevations in Arizona. During breeding, use of exfoliating bark appears to be important, with multiple roosts being used throughout a single season. Recent surveys in the Spring Mountains have documented fewer occurrences of Allen's big-eared bats than previous surveys had. The current status of the species is in question.

While most records of silver-haired bats have been during spring and fall migration periods, there is sufficient evidence that silver-haired bats are resident and breeding within the state. For example, 21 individuals of both sexes, including adults and juveniles were captured at a single spring in northeastern NV. Four lactating females were captured at McDonald Creek confirming that there is a maternity colony of silver-haired bats in high elevation (7200ft) mixed coniferous/deciduous forest (Bradley 2004). Although not confined to riparian woodlands, the majority of records indicate reliance upon these habitat corridors during migration. Occurrence of silver-haired bats in prior years within the upper Moapa Valley is in stark contrast to their absence throughout 2000 while intensive sampling occurred.

A possible summer resident at some localities throughout the state, hoary bats also migrate through the State in spring and presumably fall using riparian corridors and other wooded areas. Spring migration records of hoary bats have mostly documented females. As with other tree-roosting species, hoary bats are difficult to sample, particularly during migration. In other states, hoary bats have been documented to roost in coniferous forests. Similar forests in Nevada should be surveyed.

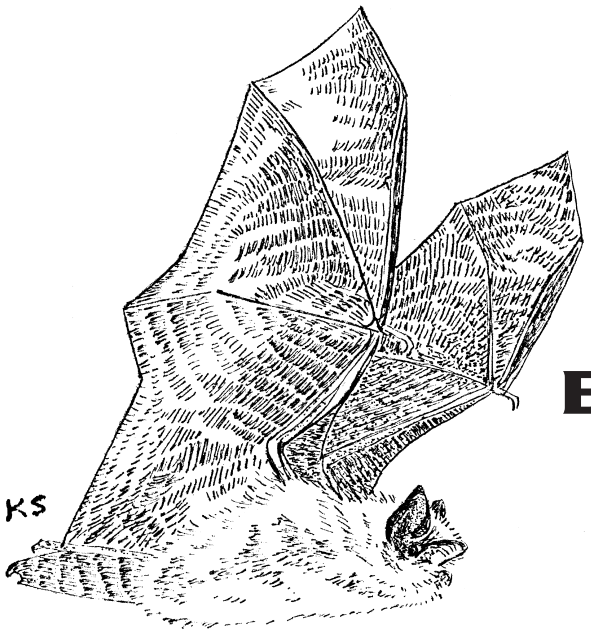
As with many species, historical records of California myotis and western small-footed Myotis found in tree roosts are exceedingly rare. This is suspected to be a result of sampling biases, as there have been very few tree roosting studies of any bat species within Nevada. We do know now that the western

small-footed Myotis will use boreal forest habitats, contrary to what Hall suggested in 1946.

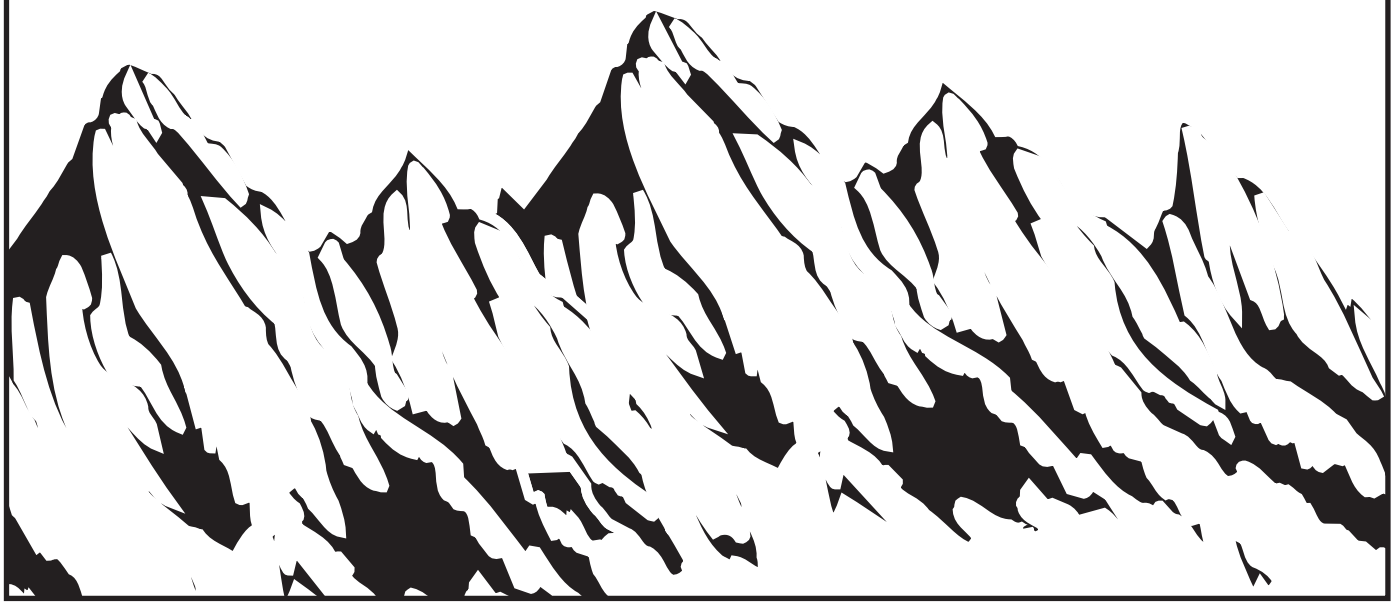
Long-eared myotis are widespread throughout Nevada in upper elevation woodlands and forests. However, with the possible exception of pinyon-juniper forest habitats in the limestone mountain ranges of White Pine County and eastern Elko County, they tend not to be abundant anywhere. They do not form large roosts and appear to alternate roosts frequently. Population declines have been noted in the Spring Mountains of Clark County, possibly due to degradation of water sources. Additional information is needed on the specific requirements of the long-eared myotis as they relate to the structure and condition of pinyon-juniper forests in Nevada.

Long-legged myotis are widespread throughout Nevada in upper elevation woodlands and forests. Trees comprise the main maternity roosts. Although common, no studies have been conducted on population trends. Because it is a common and widespread species, declines in population trends could provide an early warning for other species utilizing the same resources.

There has been no known roosting studies conducted on tree-roosting bats in Nevada. The macro- and micro-habitat roosting requirements of tree roosting species in this state is critical information that needs to be determined in order to adequately include these species in land and wildlife management plans.



Bridge and Building
Roosting Habitat










BRIDGE AND BUILDING ROOSTING HABITAT (BB)

Bridges and buildings and even dams provide analog cliff and cave roosting bat habitats throughout the world. By their very nature, most occur in urban areas. For example, Brazilian free-tailed bats form the largest assemblages of any single mammal species and can be found in high concentrations in some urban areas. A very large colony, estimated at 1.5 million individuals, occupies a bridge in Austin, Texas. Many bridges are often used as night roosts by multiple species of bats, even if the bridge does not house a day roosting colony. Bat Conservation International, along with many other researchers, have studied the characteristics of bridges that make them attractive to bats (Adams and Hayes, 2000; Davis and Cockrum, 1963; Keeley and Tuttle, 1999; Pierson et al. 1991).

In Nevada, a few known roosts in manmade structures are large, including a bridge in Reno (with an estimate of 80,000 to 100,000 individuals) and an abandoned building in McGill. Several more occur in rural settings. In northern Nevada, seven bridges have been found to support bat populations ranging from several hundred to several thousand individuals and up to five species at one site (M. Rahn, unpublished data). In southern Nevada, two bridges are known to house large colonies, although one has suffered a major decline subsequent to bridge redesign (M. J. O'Farrell, personal communication). The bats using these sites are quite vulnerable to negative impacts because they are concentrated in large numbers in very few sites.

Cooperatively constructing "bat-friendly" bridges with the Nevada Department of Transportation (NDOT) could result in enhanced bat use throughout the State. Monitoring of those sites would determine the success of this strategy. In other areas, such as Texas and California, cooperation between scientists and State Departments of Transportation are resulting in highly successful conservation projects, including retrofitting older bridges to make them bat friendly and including characteristics in new bridge construction to make them more attractive to bats.

Potential roost sites in building structures should be inventoried and monitored. Where appropriate, conservation easements with owners should be pursued to provide protection for roosting bats. Education will play an important role in the success and implementation of any bat conservation strategy relating to buildings and bridges.

Priority Bat Species

Primary Conservation Strategy

- Brazilian free-tailed bat
- big brown bat
- little brown bat
- Yuma myotis
- pallid bat
- western pipistrelle

Secondary Conservation Strategy

- Townsend's big-eared bat
- spotted bat
- California leaf-nosed bat
- California myotis
- long-eared myotis
- fringed myotis
- cave myotis
- long-legged myotis
- big free-tailed bat

CONSERVATION STRATEGY: BRIDGE AND BUILDING ROOSTING HABITAT

OBJECTIVE - Maintain stable populations of manmade structure-roosting bat species in Nevada through 2015. ("Structure" is defined as public or private buildings, bridges and dams)

Strategy: *Initiate research and monitoring to provide information on life history, population status and trend, location of key concentrations, and conservation needs of structure-roosting bats.*

Action: Identify and map key urban/rural structures with roosting populations of bats. Identify bridges and buildings with suitable features for bat roosting, and initiate surveys of likely sites to delineate the comprehensive distribution of structure-roosting bats.

Action: Conduct systematic annual outflight surveys at known large roost sites.

Action: Initiate research projects that explore the urban roost ecology, associated habitat use, and seasonal movement patterns of Brazilian free-tailed bats, big brown bats, little brown bat, Yuma myotis, western pipistrelles, and pallid bats, focusing on their use of structures, degree of tolerance to disturbance, and specific roosting requirements.

Action: Document the importance of structures to the life history of Townsend's big-eared bat, spotted bat, silver-haired bat, California myotis, western small-footed Myotis, fringed myotis, and long-legged myotis in Nevada. Some of these species are known to use structures in other states, but the extent of such use in Nevada is not well-documented.

Action: Monitor the incidence of structure use by California leaf-nosed bat, cave myotis, big free-tailed bat, and western mastiff bat and be ready to implement appropriate conservation strategies should substantial use be detected.

Action: Conduct routine monitoring of key maternity sites through the implementation of multi-agency coordinated monitoring plans specifically designed to minimize disturbance and eliminate duplication of effort. Although not suspected, determine if these roosting sites are also being used as hibernacula.

Action: Initiate research studies to quantify the economic value of urban bats to encourage local communities to protect and enhance existing populations.

Action: Identify the features of bridges and buildings that provide suitable bat roosting habitat, and develop a technical summary of bat-friendly attributes.

Strategy: *Conserve important populations of structure roosting bats.*

Action: Conserve and protect sites exhibiting substantial use by structure-roosting bats. Focus conservation efforts on the suite of roosts used by structure-roosting bats within their ecological neighborhood (adjacent foraging/watering habitat, alternate maternity and night roosts, and nearby staging areas).

Action: When appropriate, develop coordinated protection plans with local entities and responsible parties for abandoned structures containing bat roosts.

Action: Evaluate construction modification projects on existing structures for impacts to bat colonies, and provide expert input into the construction design to include bat-friendly features. Coordinate with the Nevada Department of Transportation to encourage bat-friendly bridge construction techniques when appropriate.

Action: Where protection of these resources is not an option, assist local entities and property owners with approved exclusion protocols of bats and the provision of alternate roost sites when opportunity exists.

Action: If very large colonies of bats are to be excluded, explore mitigation methods such as retrofitting existing structures for bats, erecting artificial bat boxes, and/or building new structures that are bat-friendly.

Strategy: *Create and implement an education program for the conservation of structure-roosting bats.*

Action: Develop bat watching opportunities at appropriate sites with interpretive facilities, brochures, and programs to promote the appreciation of urban bats. Develop partnerships with local Chambers of Commerce, tourist groups, businesses and adjacent landowners to promote high-quality viewing experiences and responsible stewardship of sites.

Action: Educate adjacent landowners and managers regarding the effects of management activities on local bat populations through workshops, brochures, and training. Encourage agricultural landowners to construct bat boxes as part of an integrated pest control plan.

Action: Develop partnerships with local animal control and public health officials that facilitate the distribution of factual statistics and an accurate, responsible perspective of health issues concerning bats.

Assumptions - Research and Monitoring Needs

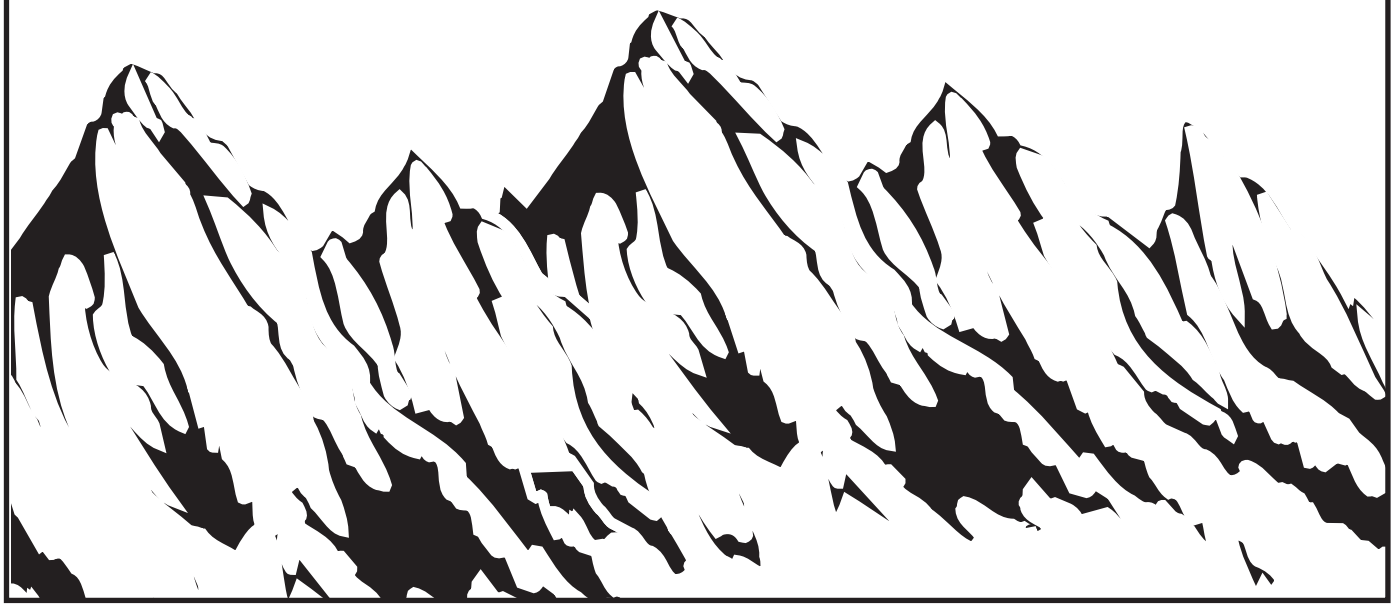
Lack of knowledge specific to Nevada regarding use and importance of structures by many species is a recurring issue. Brazilian free-tailed bats and big brown bats, for instance, are each very common species often encountered in the urban environment, but basic ecological study with an urban emphasis in Nevada is lacking. Western pipistrelles are the most common and widespread species at low to middle elevations throughout most of the western United States and can often be found in association with buildings and bridges. However, insufficient information exists on roosting requirements. Several other species, such as pallid bat, Townsend's big-eared bat, spotted bat, fringed myotis, cave myotis, long-legged myotis, and big free-tailed bats, also need more documentation of the extent of their reliance on manmade structures in Nevada. Several of these species are known to use structures in other states. Adjacent habitat use, distance to foraging areas, roost occupancy at various life stages, migration staging, and impacts by the local public are lacking for key roosting sites in Nevada. Annual monitoring and a public education program should be initiated at key sites.








Water Source
Foraging Habitat










WATER SOURCE FORAGING AND WATERING HABITAT (WS)

General Description

Water sources within desert environments are critical for several wildlife species, including bats. Bats, birds and large ungulates come from distances of up to several kilometers to meet physiological water requirements. Water sources in Nevada's deserts are essentially magnets for bats, and at least partially determine the distribution and abundance of some of Nevada's bat species. Water sources in Nevada available to bats are either natural (e.g., springs, streams, rivers, wetlands, ponds and some lakes) or artificial (e.g., troughs, spring boxes, reservoirs, some lakes and urban pools).

Many insectivorous bats concentrate their activities around riparian and wetland habitats associated with water sources as riparian areas support high concentrations of insect prey (Brigham and Fenton 1991; Grindal et al 1999). Grindal et al. (1999) found that bat activity was 40 times greater in riparian habitat at all elevations than in upland areas. Ports and Bradley (1996) found that high elevation tree roosting bat species in eastern Nevada use habitats of coniferous and/or deciduous trees associated with open water in the form of beaver ponds, stock tanks, perennial streams and springs for foraging and drinking. Hall (2000) conducted acoustic road surveys in four different areas from Mojave Desert to Great Basin Desert habitat on the Nevada Test Site, and found that approximately 90% of all bat activity occurred at water sources.

Physiologically, bats are necessarily drawn to water for maintenance of water balance during key times of the year. At the hottest and driest time of the year throughout Nevada, female bats are pregnant and subsequently lactating. Energy and water demands are quadrupled during late pregnancy and lactation (Studier et al., 1973). During the winter, a number of species are periodically active (O'Farrell and Bradley, 1969). These species have special adaptations that allow activity at low ambient and body temperatures (Bradley and O'Farrell, 1969; Hirshfeld and O'Farrell, 1976; Nelson et al., 1977; O'Farrell and Bradley, 1977; O'Farrell and Schreiweiss, 1978). The proximate cause of winter activity is water balance and the need for periodic drinking for survival through the winter (O'Farrell and Bradley, 1977).

It should be noted that not all bats roost near a water source, nor require access to drinking water. Therefore, an area without a water source is not necessarily devoid of bats.

Springs/Riparian/Wetlands

Ephemeral and perennial water should be accessible to bats. Springs are among the most widespread of the water source types, and are defined as groundwater that flows to the surface with small standing pools or sheeting flow. The majority of bats utilize both developed and undeveloped springs. Most springs serve as vital resources for bats. As bats drink on the wing, springs with accessible water offer drinking resources. Regardless of water accessibility, most springs rated in good to excellent condition sustain riparian vegetation resulting in a far richer insect fauna than surrounding upland areas. Bats congregate around these riparian areas due to the rich foraging base. Those spring riparian habitats rated in poor to fair condition typically sustain an insect forage base more reminiscent of surrounding upland habitats. Springs are a critical winter resource for several species of bats including, but not limited to: western pipistrelle, California myotis, Townsend's big-eared bats, fringed myotis and pallid bats (O'Farrell and Bradley, 1970, 1977; O'Farrell et al., 1967; M. J. O'Farrell (personal communication)]. Springs should be maintained in good ecological condition and managed at their point of origin.

When springs are developed using stock tanks or similar equipment, water should be kept available for in-flight drinking. Covers, lattice work, excessive wires, or similar structures can make artificial water sources unavailable to bats in flight and may cause injury or death. In areas with multiple springs relatively close to each other, it is important to realize that not all of these springs need to offer open

surface area for bats to drink from. This provides the land manager with more flexibility to manage these types of springs for multiple taxa or uses.

Stream/Riparian

Riparian streams, both small and large, including large irrigation channels (e.g., those found in the Fallon/Fernley area) offer both water and foraging habitat for bats. Flowing channels of water, both ephemeral and perennial, offer valuable drinking sources for most bat species.

Hoary bats, western red bats and silver-haired bats, among others, require stream riparian systems for roosting, in addition to drinking and foraging. Regardless of water accessibility, most stream riparian habitats rated in good to excellent condition sustain riparian vegetation resulting in a richer insect fauna than surrounding upland areas. Bats congregate around these riparian areas due, in part, to the rich foraging base. Those stream riparian habitats rated in poor to fair condition sustain an insect forage base more reminiscent of surrounding upland habitats. Although data are inadequate to fully understand the dynamics and importance of riparian stream systems for bats, preliminary information indicates a richer, more diverse fauna than previously known (Williams, 2001).

Lakes and Reservoirs

As with any water source, lakes, ponds, and reservoirs are important to bats. In particular, Yuma myotis and little brown bat require large ponds, reservoirs, and lakes for foraging habitat, and are typically found foraging 10-20 cm above the water surface (M. J. O'Farrell, personal communication).

Artificial Water Sources

Artificial water sources can benefit wildlife by providing water in areas devoid of any natural source. Artificial water sources come in a variety of forms, including round stock tanks, rectangular troughs, and even old tractor tires. Open water tanks can be modified by placing a fence down the middle to separate two grazing pastures, or using various wires and boards to strength the trough. Water levels within these tanks can vary considerably. Some artificial water sources include a variety of escape ramps, including floating boards, rock piles, and ramps.

Bats typically drink on the wing during flight. Bat use rates at artificial water sources can be very high, with a new bat swooping in to drink every second (BCI, 2005). Depending on the shape, number of modifications, and water level, some artificial water sources can be a source of mortality for bats. Bat Conservation International (BCI) is currently studying this issue and plans on a peer-reviewed, technical document, complete with recommendations, to be produced in early 2006. Preliminary studies have shown artificial water sources with modifications such as wires across the top that impede direct flight patterns are a source of mortality for bats, as are troughs with low water levels. Other studies have shown that it typically takes more attempts for bats to successfully drink from modified structures when compared to unmodified structures, increasing the bat's chance of injury or death (Tuttle et al. in review). Coupled with water sources that either have no escape ramp or have inadequate escape ramps, water troughs can be a threat.

Preliminary recommendations have been developed by BCI based on results from their study. These recommendations include: (1) Escape ramps should be firmly attached to the rim, and extend all the way to the bottom of the water development; (2) Ramps should be made of grippable, durable, non-slick material like expanded metal grating; (3) Ramps should be positioned to intercept animals swimming along the trough edge/perimeter; (4) Ramps should not allow animals to be trapped underneath or behind the escape ramp and should have a maximum angle of 45 degrees; and (5) Obstacles such as wooden or wire braces crossing the surface of the water or fencing separating two pastures should be minimized as much as possible. Also, because low water levels can increase the chances of injury to bats, maintaining full water troughs is ideal.

Threats to Water Source Foraging and Watering Habitat

Anthropogenic disturbances that pose negative effects to water sources directly or indirectly affect these wildlife species. Bats and the foraging and roosting resources they require should without doubt be considered when dealing with management of water resources. Examples of threats to these sites include flow regulation or impediment, improper fire management practices, OHV use, improper grazing, large scale water transfers and pipelines, and habitat loss due to unfavorable habitat manipulation.

Priority Bat Species

Obligates

pallid bat
Mexican long-tongued bat
Townsend's big-eared bat
big brown bat
spotted bat
western mastiff bat
Allen's big-eared bat
silver-haired bat
western red bat
hoary bat
western yellow bat
California leaf-nosed bat
California myotis
western small-footed Myotis
long-eared myotis
little brown bat
fringed myotis
cave myotis
long-legged myotis
Yuma myotis
big free-tailed bat
western pipistrelle
Brazilian free-tailed bat

CONSERVATION STRATEGY: WATER SOURCE FORAGING AND WATERING HABITAT

OBJECTIVE – Maintain healthy, available water sources for resident and migratory bat populations throughout the State by 2015.

Strategy: *Rehabilitate, maintain, and/or restore water sources in the State that bats frequent.*

Action: Identify and map springs, streams and lakes that bats frequent or have frequented in the past.

Action: Maintain bat access to these watering sites throughout the year, where appropriate.

Action: Coordinate with local entities to ensure that waters remain flowing to developed springs or stream riparian habitats during critical time periods, with emphasis on parturition, lactation and possibly, winter water stress periods.

Action: Negotiate conservation easements for protection and reestablishment of natural healthy conditions at springs and seeps, where possible.

Action: Manage for clean water sources at aforementioned sites by eliminating point source and non-point source pollutants, reducing upland erosion and maintaining stable bank-armoring vegetation on stream banks.

Action: Where liquids are ponded that are toxic to bats (e.g. cyanide ponds and ore dumps in gold processing operations, or oil field ponds), prevent access to and use of the ponds by bats.

Action: Initiate research to investigate the correlation between bat health and pesticide and herbicide levels in water sources, including chemicals from mining operations.

OBJECTIVE – Maintain high quality foraging habitat adjacent to water sources for resident and migratory bat populations throughout the State by 2015.

Strategy: *Restore, rehabilitate, maintain and/or enhance historical riparian habitat at spring heads, along stream corridors, and around other water sources throughout Nevada.*

Action: Identify and map water sources that bats frequent or have frequented in the past.

Action: Manage for good to excellent condition of aforementioned riparian habitats.

OBJECTIVE – Use water sources in the design of a statewide all-bat monitoring program through 2015.

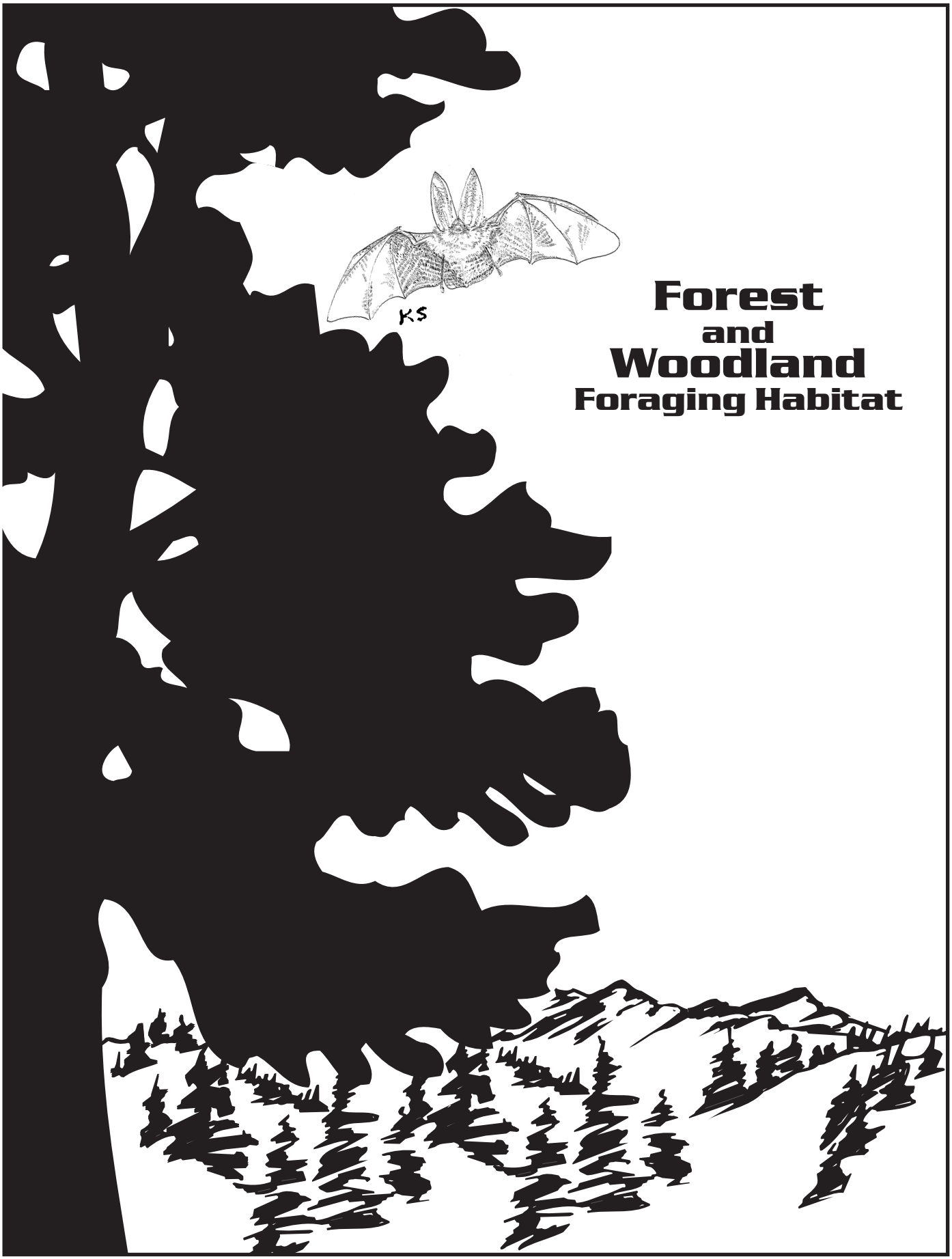
Strategy: *As part of a statewide all-bat monitoring project, employ a survey grid system at an appropriate scale (e.g., 1:100,000 m grid system) using passive long-term acoustic monitoring systems to identify long-term bat population and species composition trends throughout the state.*

Action: Array at least 60 spring and/or stream riparian survey sites (one near each grid intersection) across Nevada.

Action: In choosing sites, stratify water source locations to provide an equal effort in appropriate habitat types and elevation zones, placing additional emphasis on unusual sites (e.g. large size, habitat heterogeneity, etc). Consider the availability of historical bat data for candidate sites, the long-term viability of the available water sources and whether or not sites may provide a representative sample of the region.

Assumptions - Research and Monitoring Needs

It is assumed that most of Nevada's bats are water source obligates and that healthy, available water and productive riparian habitat benefits most of Nevada's bat species. Further research is needed to better define species/ habitat relationships. It is assumed that Yuma myotis and little brown bat require access to moderate or larger-sized bodies of water as key elements of their natural history.


KS
Forest
and
Woodland
Foraging Habitat








FOREST AND RIPARIAN FORAGING HABITAT (FW)

General Description

Cottonwood, Willow and Alder

Gallery cottonwood, willow and alder woodlands are primarily found along drainage systems with perennial water sources. Tree species within this habitat type can vary greatly from south to north and east to west in Nevada. However, most appear to provide comparable bat foraging habitat analogs throughout the state. Species of bats that roost in these types of woodlands, including western red bats, hoary bats and silver-haired bats, require these habitats for foraging as well. This type of riparian woodland habitat provides roosting and foraging habitat for several other bat species, including California myotis, long-eared myotis, little brown bat, long-legged myotis, cave myotis, big brown bats and Townsend's big-eared bats (Bradley, 2000a; Brown and Berry, 2003; Ports and Bradley, 1996). Woodland riparian habitat corridors are also critical resources for annual migrations of all three Lasiurine species, the silver-haired bat, and likely other species as well. Patches of cottonwoods and willows have been shown to furnish diverse and rich foraging sites for many species of bats (M. J. O'Farrell, personal communication).

Mesquite Bosque

Mesquite bosque habitat can be found along wash systems in the southern portion of the state. Spotted bats, western red bats and California myotis spend significant amounts of time in this habitat, presumably foraging (Williams, 2001).

Coniferous Forests and Woodlands

Coniferous woodlands of pinyon, juniper and mahogany as well as larger forests of pine, fir and spruce are found from 1,500 m to tree line near 3,500 m. Tree species within this elevation range vary greatly from south to north and east to west in Nevada. However, most of these forest types appear to provide comparable bat foraging habitat analogs throughout the state. Long-legged myotis and long-eared myotis appear to be dependent on pinyon-juniper, mountain mahogany, white fir and subalpine fir habitats for both roosting and foraging. The hoary bat has been observed roosting in Utah juniper trees in Nevada (J. A. Williams, personal communication) and has been observed spending a considerable amount of foraging/roosting time in Rocky Mountain juniper in east-central Nevada (P.V. Bradley, unpublished data), and in a mixed subalpine fir/aspen habitat type in extreme northern Nevada (M. A. Ports, unpublished data). One study found that female Townsend's big-eared bats concentrate their foraging activities within conifer forests of Utah juniper, Rocky Mountain juniper, mountain mahogany, little leaf mahogany, white fir, Englemann spruce, and bristlecone pine in August in east-central Nevada (Bradley, 2000a). Some individuals showed a high fidelity for foraging areas, returning night after night to the same pinyon/juniper stand, as far as 10 km from their maternity roost. This same telemetry data indicated no use of bajada shrub lands of sagebrush, salt desert shrub, valley bottom wetlands or agricultural lands (Bradley, 2000a). In western Arizona, Allen's big-eared bats have been observed traveling 40km one way to forage in pinyon-juniper habitat (Brown and Berry, 2004a,b). Two Townsend's big-eared bats were observed foraging at tree line in krumholz bristlecone pine and Engelmann spruce, some 1,600 m above their maternity roost at the pinyon-juniper/sagebrush ecotone.

Threats to Forest and Riparian Foraging Habitat

Much of this type of foraging habitat is in degraded condition throughout the state. Many riparian areas are severely impacted by water diversions, improper grazing, altered flood regimes, dams, and competition with exotic species. Woodlands and forests are subject to degradation from fire suppression, vegetation conversions (particularly after catastrophic fires), and fragmentation. Mesquite bosque

habitats are rapidly being lost due to urban expansion, water regime alterations, and competition with exotic species. These factors affect available foraging habitat to varying degrees throughout the state with respect to quality as well as quantity. Ideally, these types of habitats should be restored or maintained in the highest quality state possible, not only benefiting bats that use the area, but also numerous other wildlife species.

Anthropogenic disturbances that pose negative effects to these habitats also certainly have the likelihood of directly or indirectly negatively affecting wildlife species. Bats and the foraging and roosting resources they require should be considered when managing natural fires and conducting fire management practices, OHV planning efforts, and habitat manipulation efforts, including for example, forest thinning practices.

Priority Bat Species

Primary Conservation Strategy

Townsend's big-eared bat
spotted bat
Allen's big-eared bat
silver-haired bat
western red bat
hoary Bat
western yellow bat
California myotis
western small-footed Myotis
long-eared myotis
long-legged myotis
fringed myotis
western mastiff bat

Secondary Conservation Strategy

big brown bat
little brown bat
big free-tailed bat
cave myotis
Yuma myotis

CONSERVATION STRATEGY: FOREST AND WOODLAND FORAGING HABITAT

OBJECTIVE – Maintain, enhance and/or restore forest/woodland and riparian bat foraging habitats throughout the State by 2015.

Strategy: *Rehabilitate and/or maintain historical riparian woodland and mesquite bosque foraging corridors.*

Action: Identify and map existing and extirpated riparian woodland and mesquite bosque corridors.

Action: Manage corridors for good to excellent condition by controlling livestock grazing, recreational use, and discouraging the installation of new gravel mining operations and urbanization in woodland corridor floodplains and mesquite bosques.

Action: Restore existing riparian woodland corridors and mesquite bosques to healthy, productive, and self-sustaining conditions and reestablish extirpated riparian woodland sites to healthy, productive, and self-sustaining conditions.

Strategy: *Maintain a healthy mix of coniferous forest/woodland foraging habitats across the state.*

Action: Encourage the establishment of native plant communities following fire by seed application and by encouraging post-fire controls on livestock and feral horse grazing across the state.

Action: Restore woodlands that have been converted to exotic invasive annual grasslands.

Action: Where invasive exotic grasses and forbs are not an issue, encourage a natural fire regime to provide for the different seral stages of forest/woodland communities.

Action: Where invasive exotic grasses and forbs, such as cheatgrass and tumble mustard, have converted large tracts of sagebrush steppe (usually *Artemisia tridentata wyomingensis* below 30 cm rainfall) into unproductive rangeland, suppress wild land fires where applicable. Work in conjunction with land managers and encourage proper rehabilitation and temporary grazing closures on fire climax cheatgrass ranges.

Action: Conduct research (including using radio-telemetry) to determine an appropriate buffer zone around important Townsend's big-eared bat, long-eared myotis, western small-footed Myotis and long-legged myotis maternity and night roosts in pinyon-juniper woodland and subalpine coniferous forest designed to protect woodland foraging habitats near roosts. Once appropriate buffer zones are determined, these should be afforded high priority fire suppression in regional fire plans.

Action: Conduct research to determine how woodland management programs, such as mechanical and chemical removal of forest canopy, affect roosting and foraging practices of bats. Findings will help direct future woodland management practices, so that they may be conducted with minimal negative, and potential positive impacts to bats.

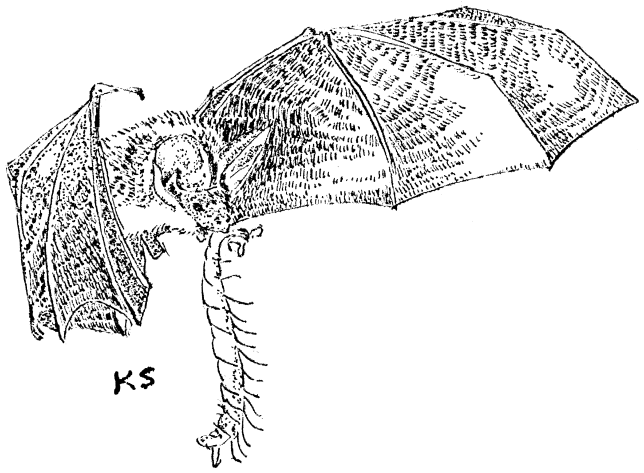
Assumptions - Research and Monitoring Needs

It is assumed that observations made of several bat species foraging in Nevada's woodlands are representative of a larger phenomenon. Many gaps exist in our knowledge of the foraging requirements for most species of bats. Further research is needed to better define species/habitat relationships.

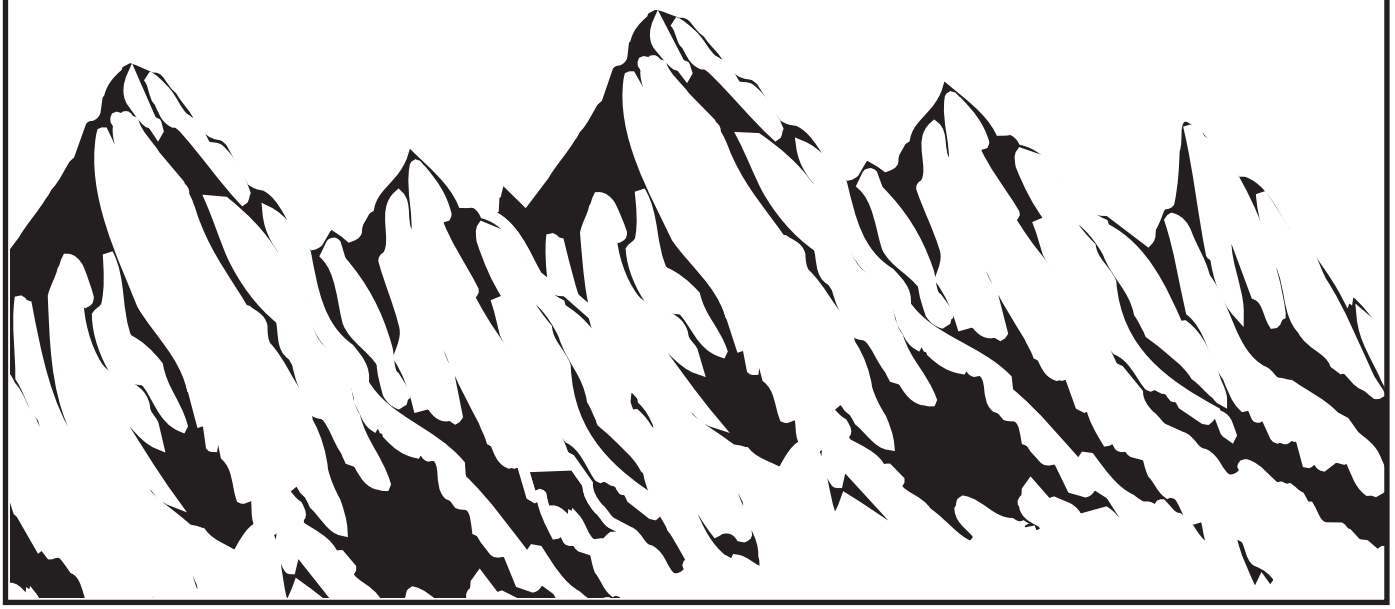






Desert Wash
Foraging Habitat










DESERT WASH FORAGING HABITAT (DW)

General Description

Desert Wash Foraging Habitat

Desert washes represent dry riparian conditions. Vegetation in desert washes varies with general habitat, elevation and latitude, but usually contain a mix of shrubs and small trees. Ephemeral water sources become available with seasonal rain. Bats will take advantage of these ephemeral water sources, but rely on desert washes primarily as foraging sites. The complexity of desert washes tends to be greater than surrounding habitats. Additionally, edge effect creates richer foraging habitat. Certain species (e.g., California leaf-nosed bats and pallid bats) concentrate the majority of their foraging time within these habitats (P. E. Brown, personal communication; M. J. O'Farrell, personal communication). Several other species spend a considerable amount of time in desert washes in winter (Ruffner et al. (1979). Bats using desert washes for foraging may be roosting nearby as closely as within the wash, but have also been document roosting as far away as 41 km (24.6 miles; Brown et al. 1993b; Brown et al, 1999).

As with woodland and riparian habitats, desert washes are declining in acreage and quality. Common environmental threats are associated with rapidly growing urban development throughout the southwest. Urban sprawl accounts for direct loss of desert wash habitat either through flood control, channelization, or by filling and building. Secondarily, increased population growth contributes to increased OHV traffic and consequent habitat degradation and destruction. Renewed mining has accounted for removal or contamination of desert wash habitat and altered water regimes have caused changes in vegetation composition.

Priority Species

Primary Conservation Strategy

California leaf-nosed bat
pallid pat

Secondary Conservation Strategy

spotted bat
Allen's big-eared bat
California myotis
fringed myotis
western pipistrelle
Brazilian free-tailed bat

CONSERVATION STRATEGY: DESERT WASH FORAGING HABITAT

OBJECTIVE – Maintain, enhance and/or restore desert wash foraging habitats for bats in Nevada by 2015.

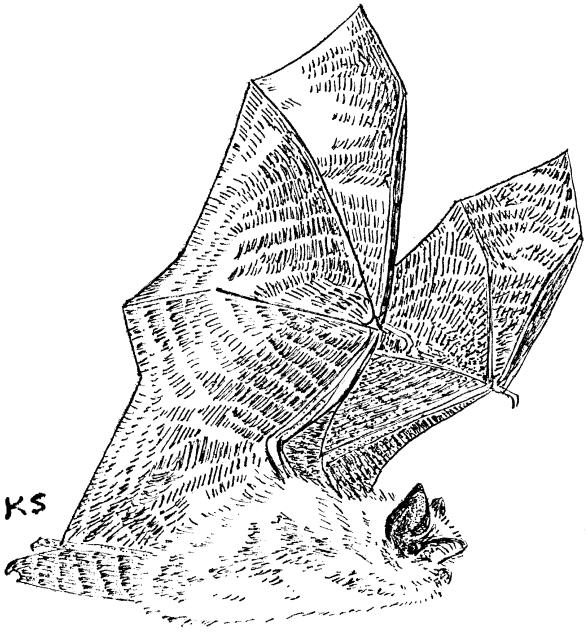
Strategy: *Rehabilitate and maintain current and, where practicable, historical desert washes.*

Action: Identify and map remaining good condition desert wash foraging habitats and manage for long-term good to excellent condition of these sites.

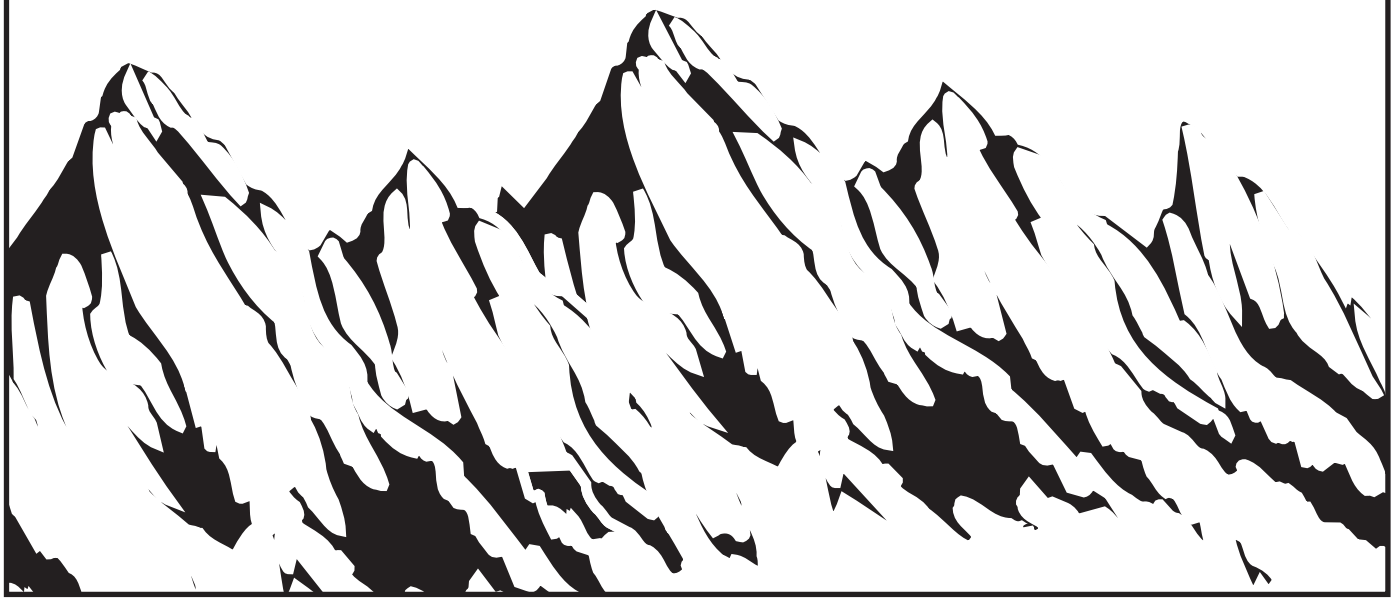
Action: Rehabilitate desert washes that are in poor condition from excessive OHV use, past mining operations or other reasons.

Assumptions - Research and Monitoring Needs

Radio-telemetry studies of California leaf-nosed bats in California have shown that they forage on large insects in desert wash vegetation. Where washes have been disturbed by mining activities close to a roost, populations of California leaf-nosed bats declined (Brown, 1993). Desert washes, especially those in proximity to known bat roosts, need to be protected from human disturbance. Adequate data are not available at this time to provide an absolute distance to protect; each area should be evaluated based on the current conditions of the habitat and threats. Other bat species also forage in desert wash habitats, preying upon various insects. The amount of habitat that each bat species requires for foraging is not expected to be consistent across species, nor is the seasonal or temporal use of such areas expected to remain static. Additional research is needed to better define species/habitat relationships across time and space in desert washes.



Other
Foraging Habitats










OTHER KNOWN FORAGING HABITATS (OFH)

General Description

Large stands of continuous shrub have not been studied in detail. From a capture method standpoint, such habitats may be very difficult or impractical to sample. There are no specific areas that can be determined to concentrate bat activity. Therefore, few areas present a situation in which to effectively sample bats when using traditional survey methods. Surveys using new acoustical methods in pure forest stands reveal sparse bat activity, primarily from animals simply moving through the habitat (M. J. O'Farrell, personal communication). Radio-telemetry has proven to be another successful method for identifying foraging habitats used by Nevada's larger bat species (Bradley, 2000a).

Mobile acoustic surveys through desert scrub have shown little concentrated bat activity (Hall, 2000; M. J. O'Farrell, personal communication). Obviously, bats must cross such areas to reach water or riparian habitats and anecdotal observations provide some evidence of casual foraging. However, little is known about the percentage of time spent foraging in such habitat or whether specific movement corridors exist as opposed to broadcast filtering throughout the habitat.

Associated with human activities are a wide variety of non-native habitats, both urban and non-urban. Agricultural areas have been observed to contain concentrated foraging activity by a variety of bats, such as pallid bats, spotted bats, big free-tailed bats, western mastiff bats, Brazilian free-tailed bats and western pipistrelles (P. E. Brown, personal communication; M. J. O'Farrell, personal communication; J. A. Williams, personal communication). Quantitative studies are lacking with respect to the importance among species of this habitat type. Although a beneficial aspect is apparent in agricultural areas, such as an abundance of insects, increased exposure to pesticides may be deleterious (Clark, 1988).

Urban areas may or may not provide a wide range of foraging resources for bats. Most data are from areas in the central and eastern United States, as few studies have been conducted in the west. Some bats use bright lights that attract insects as foraging areas, although insect control and use of energy-saving yellow street lights appear to adversely affect urban use by bats. There has been an apparent loss of bat activity in Las Vegas in older areas of the city (M. J. O'Farrell, personal communication). Currently, activity appears to be concentrated at the edge of the city. This edge is rapidly moving into native habitat with an unknown effect on bat activity. Certain features common with urban development appear to be of some attraction (e.g., golf courses, parks and sports fields). However, not all appear to be used by bats. Further research is needed to assess bat use of urban foraging habitats.

Many gaps exist in our knowledge of the foraging requirements for most species of bats. This is an area of bat research that needs substantial attention.

CONSERVATION STRATEGY: OTHER FORAGING HABITAT

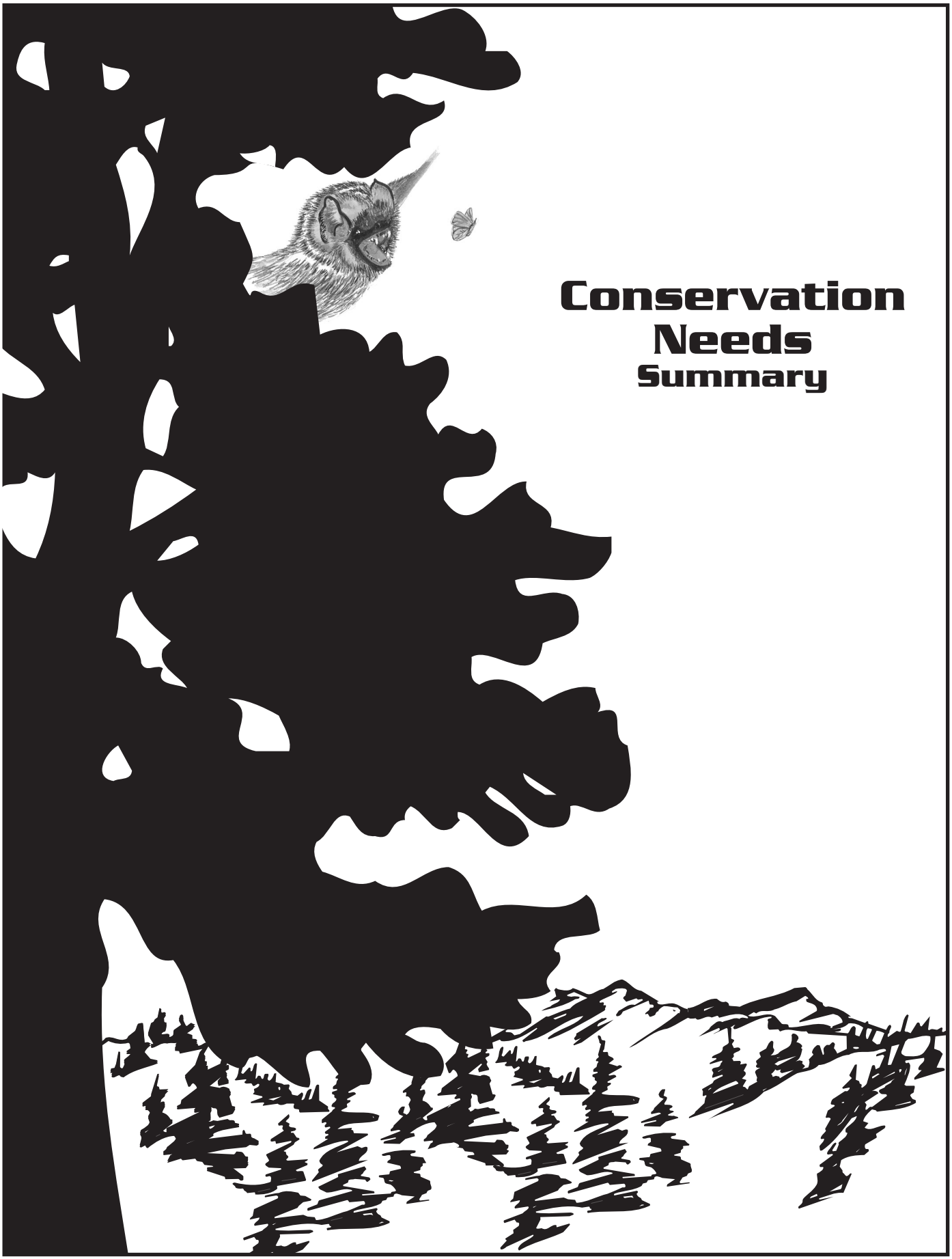
OBJECTIVE – Conserve and protect currently unrecognized bat foraging habitats when identified throughout Nevada by 2015.

Strategy: *Maintain any newly identified bat foraging habitats in good to excellent condition.*

Action: Identify and map previously undocumented bat foraging habitats and manage for long-term good to excellent condition of these sites.

Action: Once identified, if sites are in poor condition, restore foraging habitats to a good to excellent condition.

Action: Initiate passive, cost-effective survey techniques to determine to what extent bats utilize large expanses of monotypic habitat, such as desert scrub, salt bush, and sagebrush habitats away from water sources.



Conservation Needs
Summary








CONSERVATION NEEDS SUMMARY

Abandoned Mines – Suitable mines are a diminishing habitat in Nevada due to closure for hazard abatement, renewed mining and collapse due to structural instability. Although often referred to as "unnatural habitat" by land managers, mines by definition are habitat since bats have selected them as roosts. Even where caves are present, mines may be a more attractive habitat to some bat species (R. E. Sherwin, personal communication). Closure of abandoned mines without considering bats can result in bat mortality and loss of roosting habitat.

Human disturbance is a threat to mine-roosting bats. An increasing number of people are entering mines for recreation and mineral and artifact collecting. To keep both bats and people safe, mines should be closed with bat-compatible gates. These may need to be constructed to allow access to other mine inhabitants as well, such as desert tortoises. For vertical shafts, perimeter fencing (set back an appropriate distance from the shaft) or cupola gates are recommended. Agencies may also want to consider closure and reclamation of dirt roads that lead only to abandoned mines.

Some mines cannot be gated because the entrances are too large or unstable. These sites should be fenced if possible. If human safety is an important consideration because the mine is located close to cities or recreation areas, then bats should be excluded during the fall season (Brown et al., 2001), prior to hard closure and after the mine has been properly surveyed and temporary exclusion material installed. Other mines with similar microclimates in the vicinity should be gated as replacement habitat.

Mines scheduled for closure and/or destruction by renewed mining should be surveyed by qualified biologists. Survey methods will vary by season and structure types, and should include internal surveys where safe, and external surveys using acoustic detection, night-vision, and/or capture equipment. Bats can exhibit high temporal and seasonal variation in roost use, and move frequently between roosts. Multiple surveys within and across seasons are essential to determine the significance of mine structures to bats for hibernation, maternity, night roost and lek roost activities.

Recreation - Recreational caving has resulted in population declines of some cave-roosting species in Nevada. A combination of seasonal closures, sign interpretation, education, road closures, and gating have resulted in favorable population responses by Townsend's big-eared bats in northern Nevada (P. V. Bradley, personal communication).

Federal and State agencies have several objectives regarding the health, diversity, integrity, and beauty of the ecosystem. One of the main objectives is to manage and protect cave resources, as set forth in the Federal Cave Resources Protection Act (1988), while providing recreational opportunities and public safety. Adequately protecting cave resources can also benefit bats.

Other recreational activities that can have impacts on Nevada's bats can and are being addressed. As an example, the Spring Mountains National Recreation Area (SMNRA) currently limits rock climbing within 100 yards of known sensitive bird species nests and will include bat roosting habitat as it becomes known or if the need to protect that habitat is identified. Specific climbing routes may be signed as necessary to inform recreationists of seasonal closures (USFS, 1996). The BLM's Red Rock Canyon National Conservation Area (RRCNCA) has also begun working diligently to manage the impacts of climbing on natural resources.

The SMNRA and RRCNCA are also working cooperatively with climbing organizations, commercial guides, and local clubs to disperse various types of environmental educational information. Additionally, in working cooperatively with these interest groups and researchers, the Forest Service has been conducting a substantial amount of inventory and monitoring to document habitat with special biological values to

bat species, locations of forage and roost sites, and the timing of use at each site. Land agencies with rock climbing resources should follow suit.

Additional examples of potential conflicts with recreation negatively affecting bats and their necessary resources are improper location of recreation trails (i.e., OHV, mountain biking and hiking trails) too close to bat roosts, or those trails that cause loss of important habitat, especially riparian and desert wash habitat.

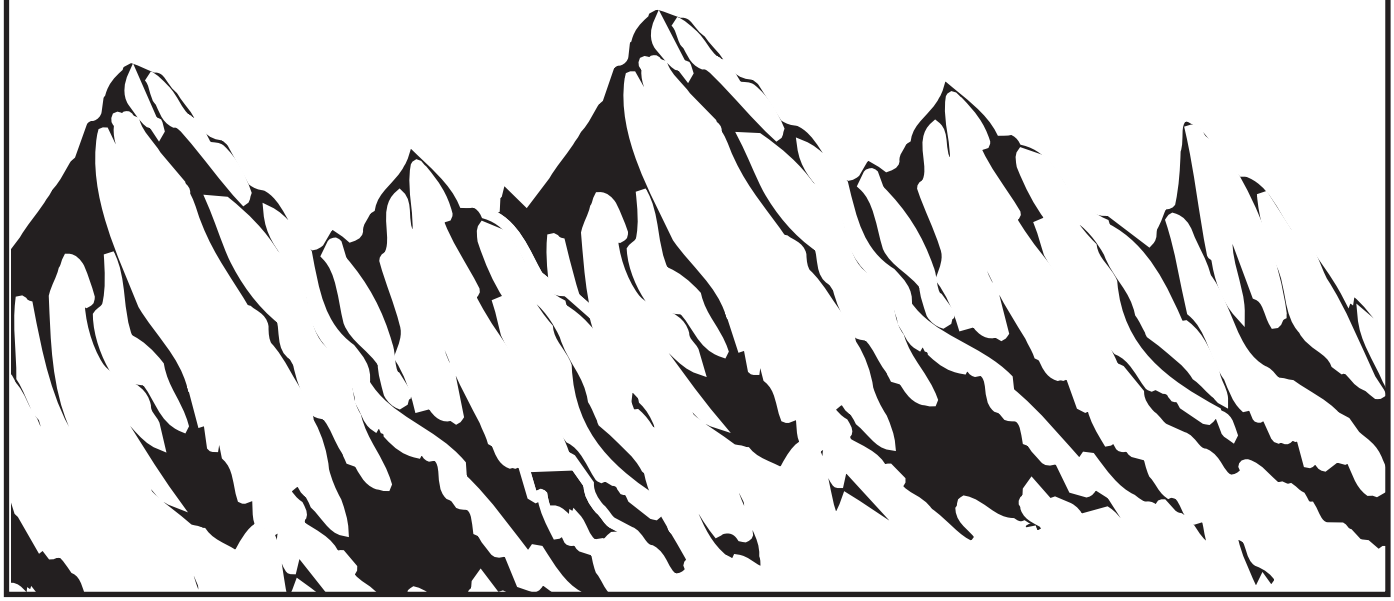
Habitat Loss/Vegetation Conversion - Large scale vegetation conversion, particularly conversion of riparian habitat to floodplain uplands from livestock grazing, herbicide application, gravel mining, and mechanical channelization have likely had a substantial negative impact on bat populations in the west. For example, data suggests that the western red bat, a riparian woodland obligate, was more abundant throughout its range, including Nevada, prior to the loss and/or deterioration of riparian cottonwood/willow gallery forests. The occurrence of Cave myotis along the Lower Colorado River have declined dramatically, and this is thought to be attributable to the substantial loss of its cottonwood riparian system (P. E. Brown, personal communication). In areas in need of restoration, livestock grazing should be managed to meet bat habitat requirements, herbicide application should avoid native riparian habitat, gravel operations should be located away from riparian floodplains and stream banks should no longer be subject to mechanical channelization.

Pinyon-juniper, an extremely valuable foraging and roosting habitat for several bat species, should be managed responsibly in order to maintain a healthy bat fauna. Management should ensure that buffers are retained around bat roosts and that a significant percentage, yet to be determined, of forest canopy be maintained in each watershed.

Fire management practices need to begin to consider how bats utilize Nevada's different habitats. There are still many unanswered questions as to the relationship between not only bats, but numerous wildlife taxa, and the current condition of Nevada's woodlands and sagebrush communities. More cryptic, is how these wildlife taxa will respond to current and future habitat manipulations occurring in the state.

Research Activities - Research activities should be conducted responsibly and with the best interest of the bat populations in mind. Protocol and permitting requirements should be adhered to, with few exceptions.

Research Needs
Summary










RESEARCH NEEDS SUMMARY

Much, but not all, of the information still needed to determine the best methods of conserving Nevada's bats can be gathered from increased inventories and routine monitoring.

Inventories throughout the state, in a variety of habitats will offer further insight into the habitat specificity of bats in Nevada. Thorough inventories will possibly identify other foraging habitat. Additionally, inventories would provide roost site delineation. There are some areas within the State that are nearly, or completely unsurveyed (Figure 24 – Page 60), and these areas should be subject to concentrated inventories in the future. Areas in the State where moderate to high levels of bat activity are identified should be monitored on a routine and long-term basis.

Routine monitoring that includes at least capture and acoustic detection methods of select locations that prove to be productive bat habitat will provide insight into migration timing and routes, short and long-term fluctuations in roost fidelity and population changes, seasonal timing of breeding congregations, reproductive timing and habitat preference. General inventory data is also gained from monitoring.

Roosting and foraging habitat delineation is necessary to more thoroughly identify critical resources for bats. Long-term acoustic and live-capture monitoring of bats will offer insight into population fluctuations, timing of migration, annual migration routes, and habitat dependency. Research should focus on habitat investigations, roosting requirements, foraging requirements, population inventories, and monitoring. Long-term monitoring stations should be established at priority sites, with special emphasis on riparian habitats and water sources (see Water Source Section), as well as at cave and abandoned mine sites. Established protocols that simultaneously sample multiple locations across the landscape will offer the opportunity to make valuable comparisons between sites. Radio-telemetry can also be a powerful tool in determining foraging habitat and roosting strategies that may otherwise remain inscrutable.

Some species specific research needs are:

Phyllostomidae
Choeronycteris mexicana **Mexican long-tongued bat**

Mexican long-tongued bats roost primarily in caves and mines. This semi-tropical bat forays northward in response to availability of flowering yucca, agave, and columnar cacti. Research priorities should emphasize the identification and description of roost sites. The single recorded occurrence of this species is thought to be accidental, although a recent capture in the Grand Canyon (C. Corben, personal communication) indicates the possibility of more regular occurrence in the area. Additionally, the documented increase in recent records for southern California indicates a possible northern spread of this species. The presence of many abandoned mines, coupled with presence of a variety of yucca and agave species suggests the potential of further occurrences in southern Nevada. Inadequate knowledge at present does not allow a better assessment of the potential of small, seasonally resident occurrences of this species.

Macrotus californicus **California leaf-nosed bat**

California leaf-nosed bats roost in warm mines and caves, and exhibit high roost fidelity. Population trends for this species are best documented from roost exit counts conducted using a standardized protocol. Winter roosts appear to be the most limiting. The species does not hibernate or tolerate lowered body temperatures. Winter roosts must be stable and warm. During the winter, weather conditions must be sufficiently mild to allow frequent nightly activity for foraging. Although some new roosts have been found, most historical locations have been destroyed. A recent discovery of populations

in the upper Moapa Valley and Meadow Valley Wash document an important new occurrence and possible extension into Lincoln County. Proposed development in this region makes it critical to identify exact distribution and resources in order to provide protection. Information on the use of gated mines and caves, and more information on foraging habitat in southern Nevada are also needed.

Vespertilionidae

Antrozous pallidus **pallid bat**

Pallid bat populations have been declining in California, apparently due to roost disturbance. Nevada may have a similar situation. However, few roost sites have been identified in Nevada and no population studies have been conducted. The largest known maternity roost in Nevada is in a moderately unstable mine adit that has been gated, although other smaller maternity colonies are known. Pallid bats also use boulders for roost sites, including maternity roosts. However, few of these types of roosts have been identified in Nevada. Location and protection of these features are critical to a stable, healthy population. Currently, the lack of comparative baseline data hampers an appropriate evaluation of trends and needs.

Corynorhinus townsendii **Townsend's big-eared bat**

Priority status was determined for the Townsend's Big-eared bat in Nevada based on: a) the downward population trend documented in the surrounding states of California, Oregon, Washington, New Mexico and Idaho; b) documented roost population declines in Nevada; and c) the well-documented sensitive nature of this species to human disturbance of roost sites. A far more broad-scaled and complete monitoring effort is needed in Nevada to truly discern the status and trend of this species.

Eptesicus fuscus **big brown bat**

Big brown bats are found throughout most of North America and appear to be common over much of their range. Although many records occur for Nevada, little is known of roost sites and seasonal habits. The first roost record for this species in Nevada was in a natural cave in 1928 near Overland Pass in the southern Ruby Mountains (Borrell and Ellis 1934). Additional documentation of tree, mine and building roosting big brown bats is necessary to determine the extent of their reliance on these roost structures. Research priorities for big brown bats should emphasize the identification and description of roost sites, including winter hibernation sites. Because of its widespread distribution and apparent abundance, population trend analyses for the big brown bat may have broad applications in bat management and conservation.

Euderma maculatum **spotted bat**

Spotted bats are highly associated with prominent rock features and are dependent upon rock-faced cliff roosting habitat. As with most species of bats, there is complete lack of specific cliff and talus roosting information for spotted bats in Nevada. They will secondarily roost in caves and mines, although these observations have been primarily during winter hibernation. Additional documentation of cave and mine roosting spotted bats are necessary to determine the extent of their reliance on these roost structures. Research priorities for spotted bats should emphasize the identification and description of roost sites and their breeding range within the state. The confirmation of this species in five counties is an improvement over 1946 (one record in Reno). However, there remains much more work to be done to identify the extent of spotted bat distribution and its status in Nevada.

Idionycteris phyllotis **Allen's big-eared bat**

Allen's big-eared bat is found only in southern Nevada from a few locations with most being concentrated in the southern portion of the Spring Mountains in Clark County. Throughout its range, its distribution appears patchy. This species appears to breed in coniferous forest and winter at lower elevations. Two

populations have been found breeding at low elevations in mines in Arizona. These individuals commute long distances (40km) to reach foraging areas in mesquite grasslands and pinyon-juniper where other abandoned mines are abundant (Brown and Berry, 2004).

During breeding, use of exfoliating bark as tree roosts appears to be important with multiple roosts being used throughout a single season. Recent surveys in the Spring Mountains have located very few Allen's big-eared bats in the Spring Mountains (O'Farrell, 2002a). The current status of the species is unknown but seems to be in decline. Research should focus on monitoring and delineating the status of this species.

Lasionycteris noctivagans silver-haired bat

Silver-haired bats have been documented in surveys during migration periods Most records are from spring and fall migration. In 2004, four lactating females were caught in northeastern NV in mixed coniferous/deciduous forest, indicating that the species is breeding in the state. One active individual was observed flying during mid-day during January 2003 in Spring Valley near flowing water, suggesting forests in eastern Nevada are used as hibernacula (J. A. Williams, personal communication). Although not confined to riparian woodlands, the majority of records indicate reliance upon these habitat corridors during migration. Occurrence of silver-haired bats in prior years within the upper Moapa Valley is in stark contrast to their absence throughout 2000 while intensive sampling occurred.

Silver-haired bats roost almost exclusively in trees. The only time of the year that they have been documented to use alternative roosts, such as natural caves, mines, cliffs and taluses is during winter hibernation. Studies conducted to document the presence of silver-haired bats in the aforementioned structures should be conducted in the appropriate season. Surveys in Nevada should focus on delineating seasonal patterns, locating maternity roosts, and monitoring of these roosts to better understand the status of the species within NV.

Lasiurus blossevillii western red bat

Historically, western red bats are not well documented in Nevada. With the recent availability and use of more technologically advanced methods of bat detection, records of western red bats in Nevada are increasing. Although not documented historically, this species is now known to occur very rarely in Moapa Valley and Meadow Valley Wash in southern Nevada (Williams, 2001; Tomlinson and Kenney, 2005). This species is thought to be in serious population decline throughout its range and is known to roost primarily in cottonwood galleries associated with water systems. Widespread cottonwood gallery loss is suspected to be the primary contributing factor towards the decline of this species. Research should focus on: 1) conducting widespread fine scale inventories using acoustic equipment to document this species' state distribution; 2) determining its tree roosting requirements; and, 3) documenting the change in the abundance and distribution of cottonwood galleries in the State.

Lasiurus cinereus hoary bat

A potential summer resident at some localities throughout the State, hoary bats also migrate through the State in spring and fall using riparian corridors and other wooded areas. Most capture records for this species in Nevada are of males in the Spring season. As with other migratory obligate tree-roosting species, they are difficult to sample. Recent work in the upper Moapa Valley indicates that hoary bats are present in the State for longer periods than previously thought and that remaining riparian corridors may be essential as migration stop over sites. Further degradation or loss of these key habitats could have deleterious effects for the species throughout the western United States.

Lasiurus xanthinus **western yellow bat**

The recent documentation of western yellow bats in southern Nevada represents the first State record for this species and a substantial range extension. The increase in distribution is possibly attributable to the increase in decorative palms within and surrounding urban development in the southwestern United States. The establishment of a stable year round population in southern Nevada is important. Although present throughout the year, it appears that a major portion of the breeding population migrates south for winter. Nothing is known of the migration route or destination, but it is expected to occur in association with water systems, such as the Colorado River. Maintenance of a viable migration corridor and foraging areas will be critical to the success of western yellow bats in Nevada. Research should focus on delineating the population and its status within Nevada, focusing on both urban and rural areas.

Myotis californicus **California myotis**

Records of California myotis found in abandoned mines in Nevada indicate widespread use but typically in low numbers. Use includes night roosting, day roosting and hibernation. California myotis also use cliff, crevice, and talus habitats, but as with most crevice roosting bat species, virtually nothing is known about what portion of the population uses such roosts or any of the physical characteristics required for such a roost. As with many species, historical records of California myotis found in tree roosts are exceedingly rare. Individuals are suspected to move from roost to roost throughout the year, but nothing is known of this dynamic. Determination of roost requirements, use of multiple roosts, and frequency of roost switching is critical to proper conservation and management of mine and cave resources. Information on the use and acceptance of bat gates, and more information on foraging requirements is also needed. No information is known on population trends for the California myotis. Because it is a common and widespread species, declines in population trends may provide an early warning for other species utilizing similar resources.

Myotis ciliolabrum **western small-footed Myotis**

For a seemingly common and widespread bat throughout most of Nevada, very little is known about the western small-footed Myotis. Reliance on caves and mines for hibernation and maternity use as well as night roosting is substantial. Outside of Nevada, western small-footed Myotis have been found using crevices and holes in rock faces and hollows in trees. However, few roosts have been identified. Maternity colonies appear to be small, so roosts may be many and widely scattered. A large hibernating group found in a deep, complex abandoned mine in eastern Nevada suggests winter congregations in fewer structures, similar to other myotis species. Such congregations place a large proportion of the population at risk from a single disruptive event. Also, these roosts can be several hundred meters underground with the only access being a vertical shaft, making these sites extremely difficult to monitor. New passive monitoring techniques hold promise for this species. Because it is a common and widespread species, declines in population trends may provide an early warning for other species utilizing similar resources.

Myotis evotis **long-eared myotis**

Long-eared myotis are widespread throughout Nevada in upper elevation woodlands and forests. However, they tend not to be abundant anywhere with the possible exception of pinyon-juniper woodlands in limestone mountains. They do not appear to form large roosts and seem to alternate roosts frequently. Population declines have been noted in the Spring Mountains of Clark County, potentially due to degradation of water sources. Additional information is needed on the specific needs of the long-eared myotis as they relate to the structure and condition of pinyon-juniper forests in Nevada. Caves and mines are not only used as roost sites but also may be used for foraging sites. Little is known about the cliff and crevice roosting behavior of this species in Nevada.

Myotis lucifugus **little brown bat**

Although the little brown bat is common in other areas of its range, it seems rare in Nevada, with a patchy distribution in the northern portion of the state. Local distribution and abundance is unknown. This species is known to form maternity roosts in bat boxes at Ruby Marsh NWR. It hibernates in large aggregations elsewhere but no winter roosts have been located in Nevada. Any disturbance or destruction of bats or their hibernation sites could have profound impacts to the regional population as a whole. This species is often associated with larger bodies of water or rivers. Often, roost sites are associated with these aquatic features. Specific attention should be focused on the roost sites located near these waters as well as the protection of the water sources themselves.

Myotis thysanodes **fringed myotis**

Prior to 1974, the fringed myotis was known from only two locations. The only known colony, found in a salt cave outside of St. Thomas, was inundated with the formation of Lake Mead. Since 1974, there have been a number of records through the middle and upper elevations of southern Nevada, and two maternity roosts have been found in adits on the Nevada Test Site (D. B. Hall, personal communication). This species is particularly sensitive to disturbance in day roosts. Systematic surveys are critical to locate and protect roost sites.

Myotis velifer **cave myotis**

Hall first predicted a Nevada distribution for the “broad-toothed Myotis” along the Colorado River in 1946. The cave myotis is known from only one location in extreme southern Nevada. Historically, this roost was a maternity roost, but two recent surveys only captured males suggesting that this is no longer a breeding colony. The population occurs in an abandoned mine complex in a remote portion of the Lake Mead National Recreation Area. This population appears to be linked with a historically more extensive distribution on the Arizona side of the Colorado River (P. E. Brown, personal communication). The presence of numerous abandoned mines along the Colorado River in Nevada provides the infrastructure for more widespread occurrence of cave myotis. However, the little known information on population trends for the cave myotis suggests precipitous declines in roosts along the entire Colorado River. Along the lower Colorado River, three maternity colonies in California are known. Population declines may be related to loss of the cottonwood riparian habitat and changes in prey base. Possibly, pesticide use may have caused direct and indirect reductions. Research should be conducted into contaminant levels in old guano deposits. Information on use and acceptance of bat gates, and more information on roosting and foraging requirements are also needed.

Myotis volans **long-legged myotis**

The long-legged myotis is widespread throughout Nevada in upper elevation woodlands and forests. Trees comprise the main maternity roost although there are at least 3 maternities colonies known that occur in mines. Caves and mines may also be used for large bachelor roosts as well as for general night roosting. Crevices and cliff faces have also been found to provide alternate roosting habitat. However, the specific roosting requirements of this species in all habitat guilds is generally unknown and needs further investigation. Information on the use and acceptance of bat gates, as well as foraging requirements are also needed. Although common, no studies have been conducted on population trends. Because it is a common and widespread species, declines in population trends may provide an early warning for other species utilizing similar resources.

Myotis yumanensis **Yuma myotis**

Generally, Yuma myotis require medium to large bodies of water for foraging. Roosts are often within the vicinity of these types of water bodies. For example, known large roosts are located in a mine near

Rye Patch Reservoir and in Davis Dam. Specific attention should be focused on the roost sites located along these areas as well as the protection of the water sources themselves.

Pipistrellus hesperus **western pipistrelle**

Western pipistrelles are the most common and widespread species at low to middle elevations throughout most of the western United States. Because of their abundance and widespread distribution, they are well-suited for long-term monitoring of population trends. Fluctuations in western pipistrelle populations may serve as an early warning for other species utilizing similar resources. Insufficient information exists on roosting requirements.

Molossidae

Eumops perotis **western mastiff bat**

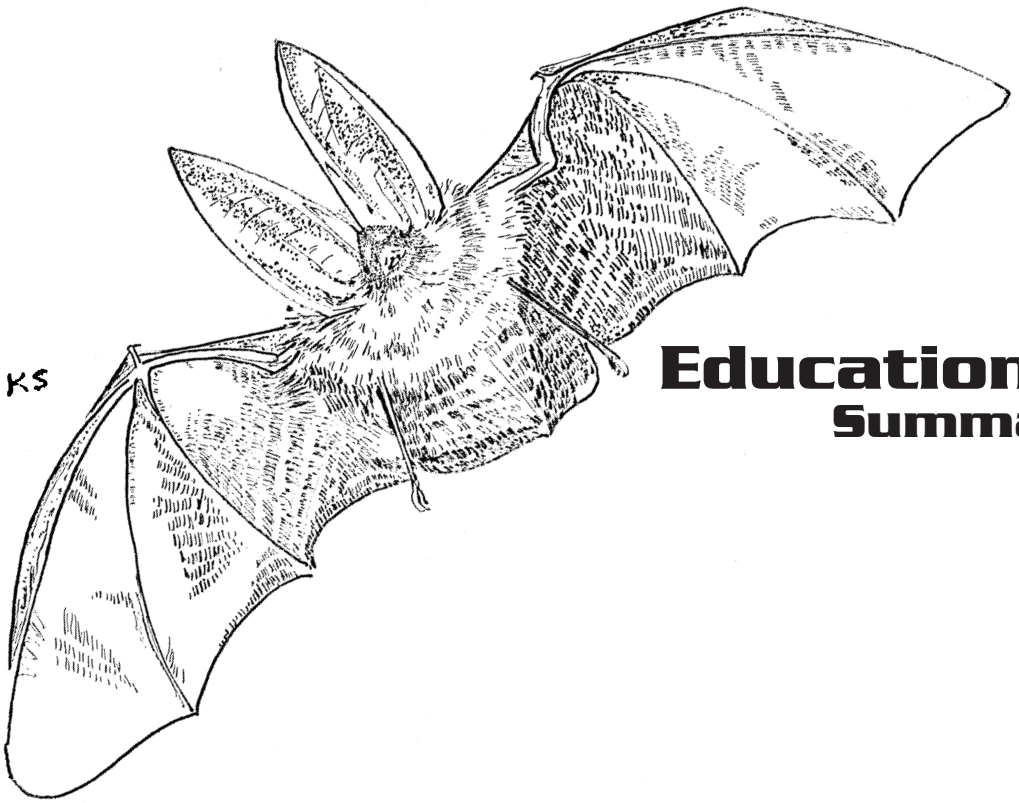
Until recently, the western mastiff bat was known only from Clark County. A single historic record exists from 1967 from the Las Vegas Valley. No other records from Nevada were collected until beginning in 2001. Since 2001 this species has been documented acoustically in Kyle Canyon in the Spring Mountains (O'Farrell, 2002b), the Las Vegas Wash, (M. J. O'Farrell, personal communication) and Meadow Valley Wash in Lincoln County (Tomlinson and Kenney, 2005), and along the Colorado River near Davis Dam and in the southern vicinity of Lake Mead National Recreation Area (Brown, 2003). Research should focus on documenting this species' southern Nevada distribution, and identifying its specific roosting requirements. Recent studies in California indicate the species is more widespread than previously thought.

Nyctinomops macrotis **big free-tailed bat**

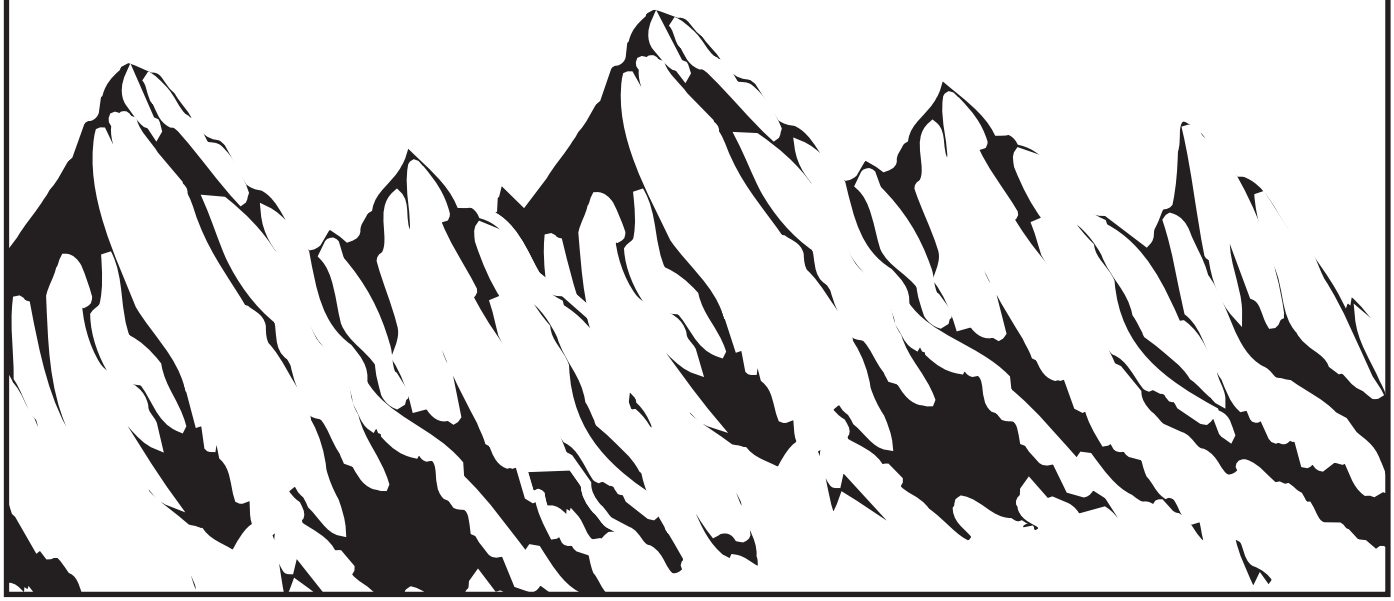
Big free-tailed bats have not been found to hibernate in Nevada and are presumed to be seasonal migrants only. This species is only known to occur in Clark County, and has only been documented in Nevada during fall migration. Until 2000, this species was known from only a single confirmed location in the Las Vegas Valley. In 2000 and 2001, intensive acoustic monitoring within the upper Moapa Valley documented big free-tailed bats occurring from September through October (Williams, 2001). Big free-tailed bats were also detected at Meadow Valley Wash in Lincoln County in 2003 (Tomlinson and Kenney, 2005). Considering this species is widespread throughout the lower half of Utah, it is likely that occurrence of this species exist in additional areas throughout the central and eastern portions of Nevada. It is a high flying species that is difficult to capture, probably resulting in under-representation in past capture-based inventories.

Tadarida brasiliensis **Brazilian free-tailed bat**

Brazilian free-tailed bats form the largest assemblage of any single mammalian species. They are known to migrate long distances, although recent observations in southern Nevada indicate year round presence of a portion of the state's population. Few roosts and no winter roosts have been located. The sensitivity of large numbers of individuals in few roosts is high. Of the known roost sites in Nevada, there are a select few that contain colonies in excess of 50,000 animals. A loss of any one of these colonies could be detrimental to the species' range within the state Increased human development, population growth, and recreational activities present substantial threats to these roosts. The protection of roost sites for this species is complicated by their unwillingness to accept gated closures of main roost caverns. Additional information is needed on migration and foraging behavior. In Nevada, the most well-known roosts for Brazilian free-tailed bats occur in caves and man-made bridges. However, cliff, crevice, and tree roosting habitats may provide habitat for important segments of the population during portions of the year. Research needs include identifying and understanding foraging areas used by urban roosting populations, and determining the levels of disturbance that do and do not negatively affect urban roosting populations.



Education Needs
Summary










EDUCATION NEEDS SUMMARY

Conservation Education – Several recent technological advances have made it easier to provide quality bat educational materials to the public. The following is a list of potential activities that would increase public awareness of the benefits of bats to Nevada's ecosystems:

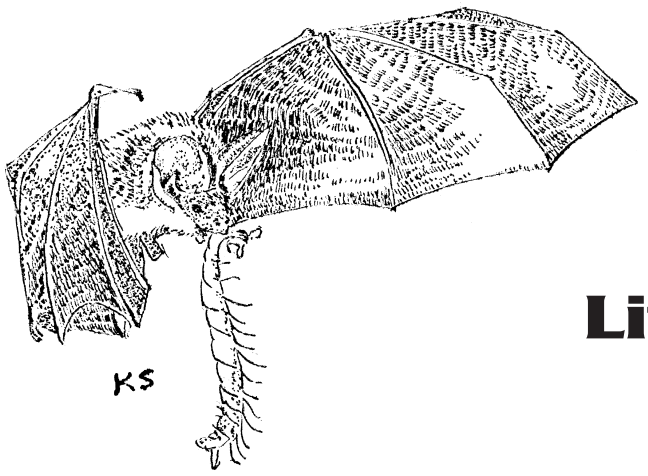
1) Develop a website specific to Nevada bats.
2) Internet wildlife video cam viewing.
3) Field tour bat monitoring of spring sites, bridge sites, etc.
4) Bat posters.
5) School presentations.
6) Civic presentations, including an educational Powerpoint presentation
7) Consider pursuing a change in State law to allow for licensed wildlife rehabilitators to work with bats (currently this is prohibited). Unreleasable bats, used in the proper context with proper safety measures in place, can be an effective educational tool.

In 2005, the Nevada Department of Wildlife produced both a Nevada bat brochure and a bat video. Both of these products will be essential for conservation education.

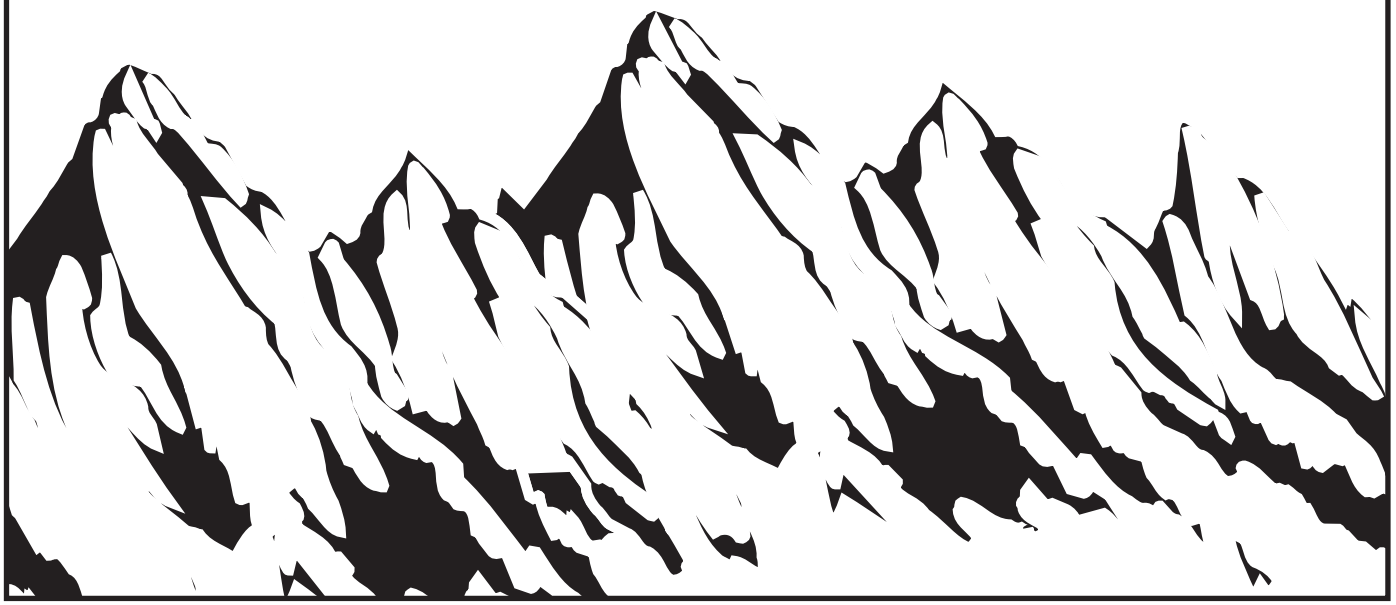






Literature Cited







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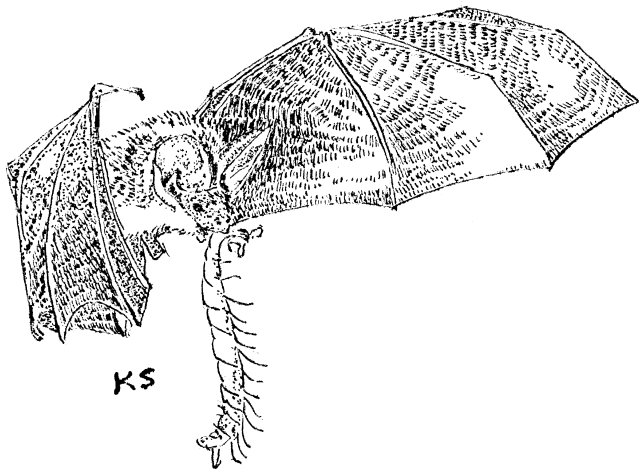
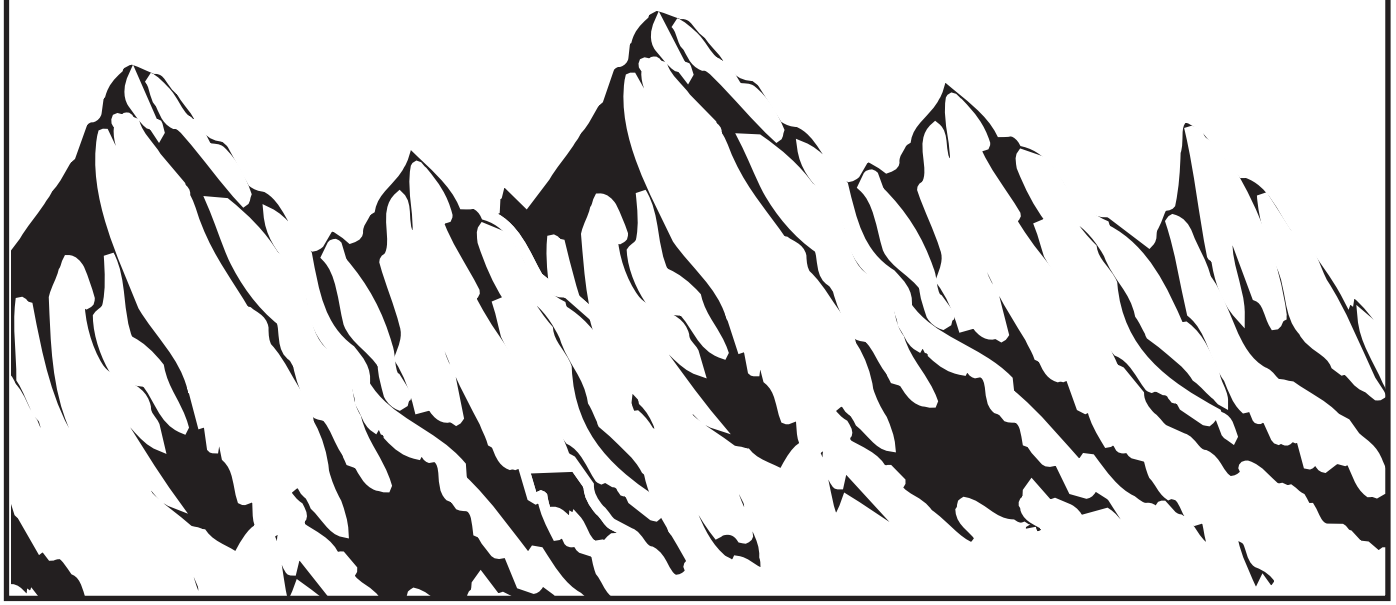


Appendices



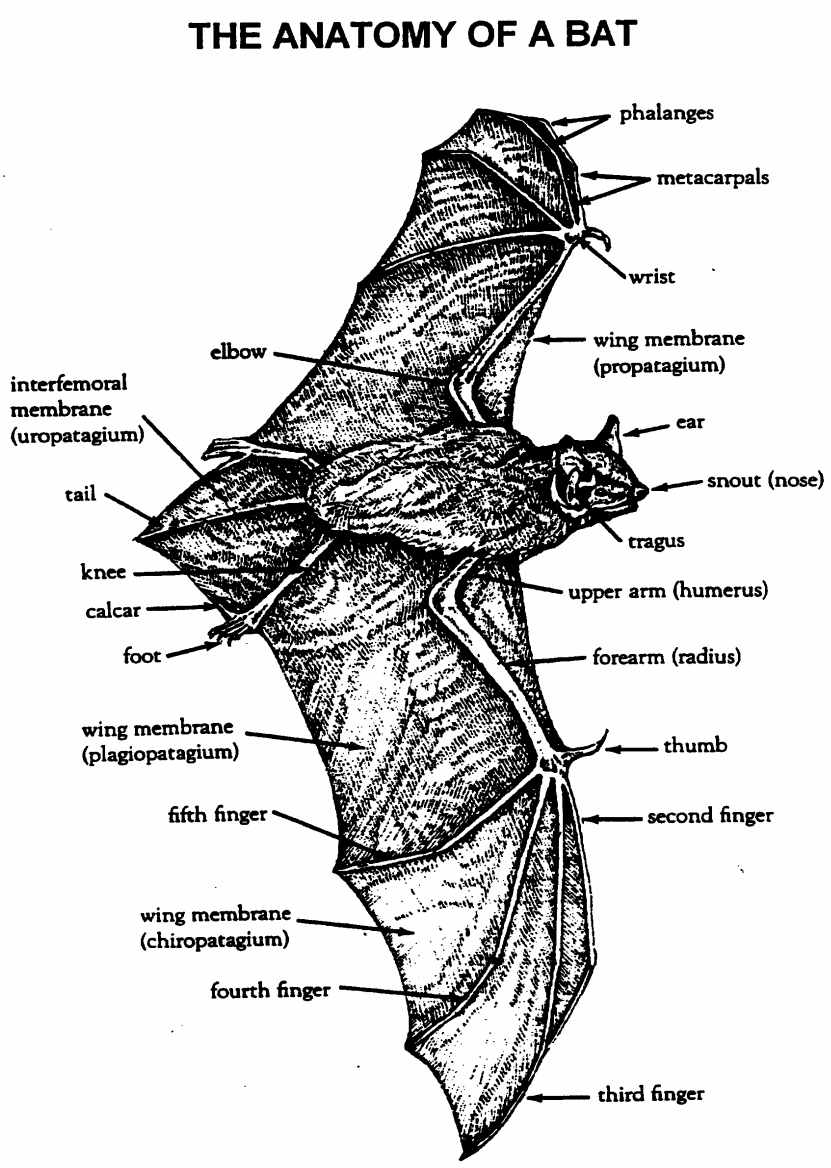






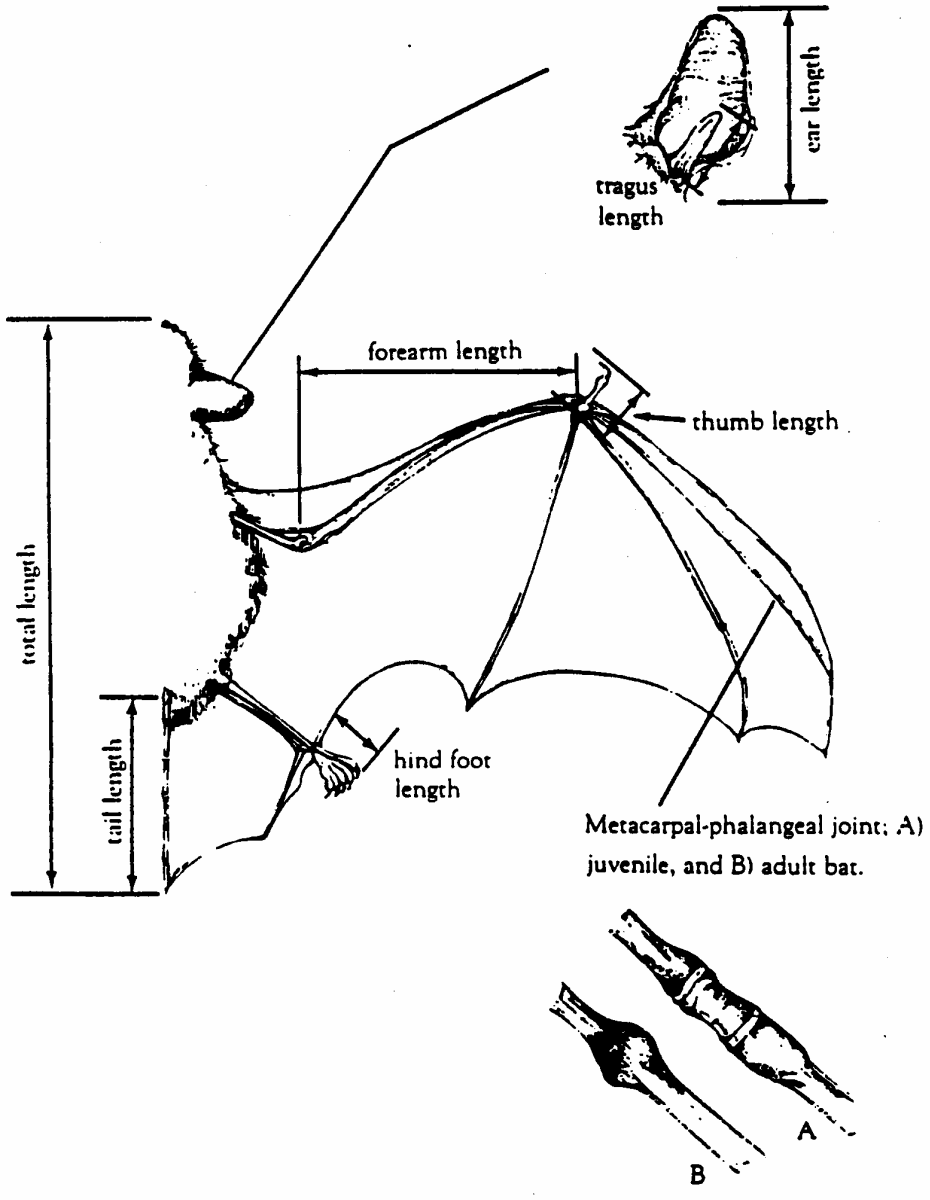

APPENDIX A

Inventory, Monitoring, and Research Guidelines



Source: "The bats of Texas" by David J. Schmidly, drawing by Christine Stetter

Measurements used in Species Identification Keys



Metacarpal-phalangeal joint; A) juvenile, and B) adult bat.

KEY TO THE BATS OF NEVADA

1 a. Nose with a prominent leafy projection (Fig. 1) (Family PHYLLOSTOMIDAE) —
b. Nose without prominent leafy projection — 3

Figure 1a

Figure 1b

2 a. Ears large (> 25 mm) (Fig. 1a); tail prominent (> 30 mm) — *Macrotus californicus*
b. Ears < 25 mm; tail absent or vestigial; nose elongate (Fig. 1b) — *Choeronycteris mexicana*

3 a. Approximately 50% of tail extending beyond the trailing edge of the interfemoral membrane (Family MOLOSSIDAE) — 4
b. Tail fully within the interfemoral membrane with no more than a few millimeters extending beyond the edge of the membrane (Family VESPERTILIONIDAE) — 7

4 a. Forearm < 55 mm — 5
b. Forearm > 55 mm — 6

5 a. Ears not joined at the base although occasionally meeting (Fig. 2a); 2nd phalanx of 4th digit > 5 mm (Fig. 2c) — *Tadarida brasiliensis*
b. Ears joined at the base (Fig. 2b); 2nd phalanx of the 4th digit < 5 mm (Fig. 2d) — *Nyctinomops femorosaccus* [Not known from Nevada but recent extensions of the known range in northern Arizona suggests looking for this species at least in Clark County]

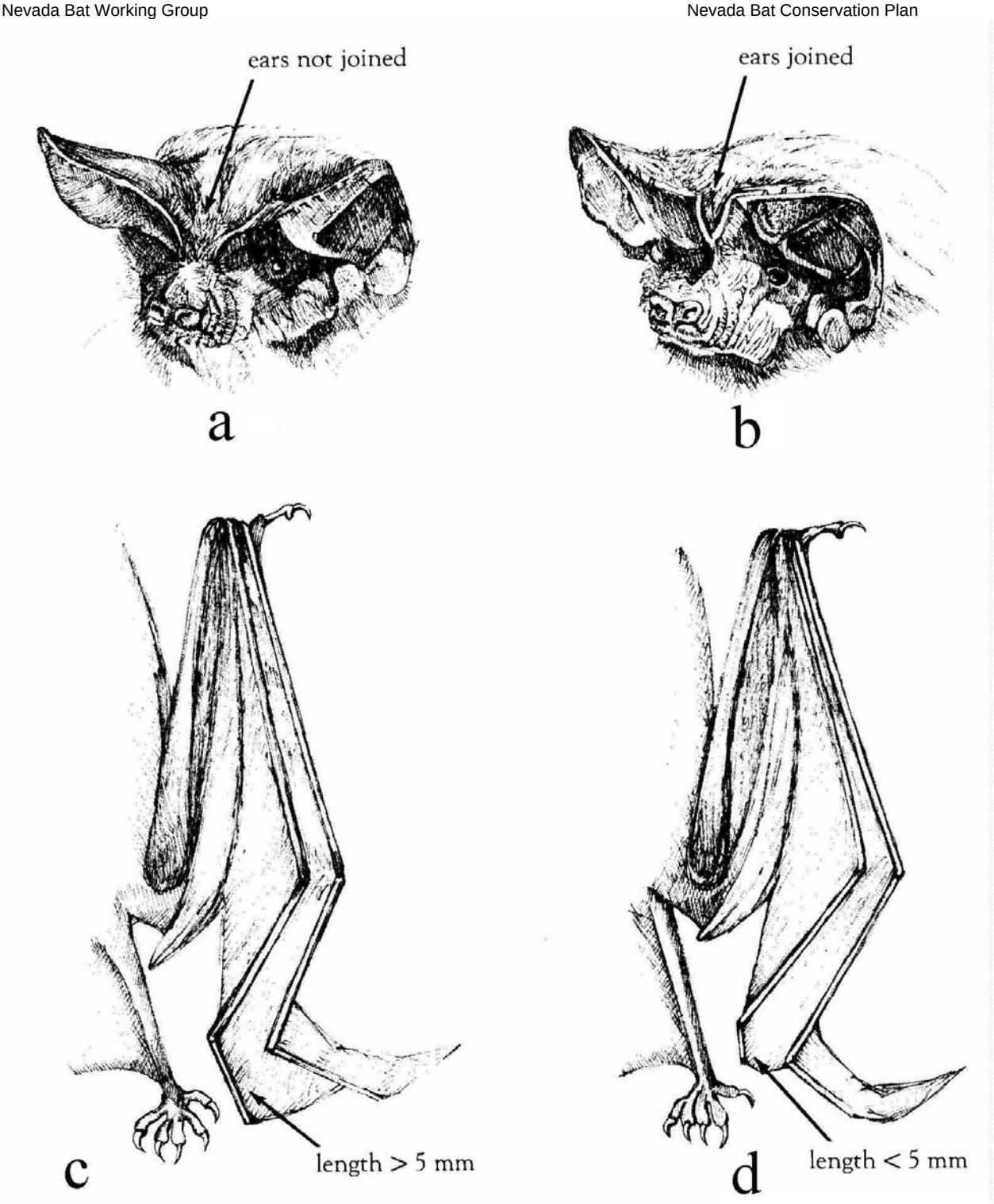


Figure 2

6 a. Forearm < 70 mm; upper lip with deep vertical wrinkles — *Nyctinomops macrotis*
b. Forearm > 70 mm; upper lip smooth — *Eumops perotis*

7 a. Ears large (> 28 mm from notch to tip — 8
b. Ears < 28 mm from notch to tip — 11

8 a. Dorsal fur black with 3 large white spots on the back — *Euderma maculatum*
b. Fur color variable but not black; no white spots — 9

9 a. Two lappets projecting over forehead from the base of the joined ears (Fig. 3a) — *Idionycteris phyllotis*
b. No lappets present between the base of the ears — 10

Figure 3a

Figure 3b

10 a. A conspicuous lump on either side of the snout (Fig. 3b); fur brown to gray — *Corynorhinus townsendii*
b. No conspicuous lump on either side of the snout; fur pale yellowish — *Antrozous pallidus*

11 a. At least the anterior half of dorsal surface of interfemoral membrane well-furred — 12

b. Dorsal surface of interfemoral membrane naked or anterior third sparsely-furred — 15

12 a. Dorsal fur black with many hairs distinctly silver-tipped — *Lasionycteris noctivagans*

b. Color variable but never uniformly black; fur may or may not be silver-tipped — 13

13 a. Posterior half of dorsal surface of interfemoral membrane bare or with scattered hairs; yellow coloration; forearm 42-48 mm — *Lasiurus xanthinus*

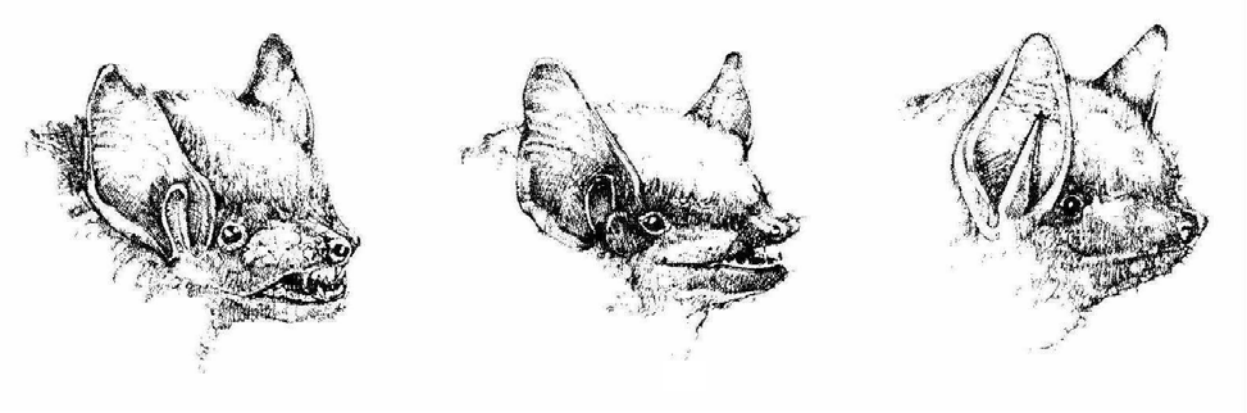
b. Entire dorsal surface of interfemoral membrane well-furred — 14

14 a. Forearm 38-43 mm; reddish coloration — *Lasiurus blossevillii*

b. Forearm 48-58; mahogany brown coloration with distinct silver-tipped fur — *Lasiurus cinereus*

15 a. Tragus short (<6 mm), blunt, rounded, and curved (Fig. 4a or b) — 16

b. Tragus long (> 6 mm), pointed, and straight (Fig. 4c) — 17



a) broad, rounded tragus b) curved, blunt tragus c) straight, pointed tragus

Figure 4

16 a. Forearm > 40 mm — *Eptesicus fuscus*

b. Forearm < 40 mm — *Pipistrellus hesperus*

17 a. Ear > 16 mm — 18
b. Ear < 16 mm — 19

18 a. Conspicuous fringe of hair on posterior edge of interfemoral membrane (Fig. 5) — *Myotis thysanodes*
b. No conspicuous fringe of hair on posterior edge of tail membrane but some hairs possible; ears 20-24 mm — *Myotis evotis*

Figure 5

19 a. Calcar with keel (Fig. 6) — 20
b. Calcar without keel — 22

Figure 6

20 a. Hindfoot > 8.5 mm; forearm 35-41 mm; ventral wing surface haired from elbow to the knee — *Myotis volans*

b. Hindfoot < 8.5 mm — 21

21 a. Forehead rising abruptly from the rostrum (Fig. 7); when viewed from above, naked part of snout about as long as width of nostrils; thumb usually < 4 mm; tip of tail does not extend beyond edge of interfemoral membrane (Fig. 8b, d) — *Myotis californicus*

b. Forehead sloping gently from the rostrum (Fig 7); when viewed from above, naked part of snout ca. 1.5 times as long as width of nostrils; thumb usually > 4.5 mm; tip of tail extends ca. 2 mm beyond edge of interfemoral membrane (Fig. 8a, c) — *Myotis ciliolabrum*

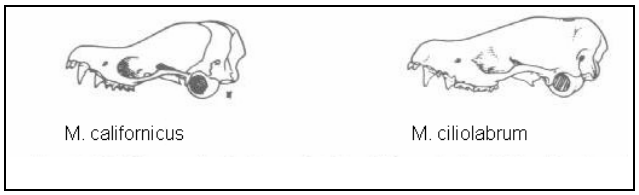


Figure 7

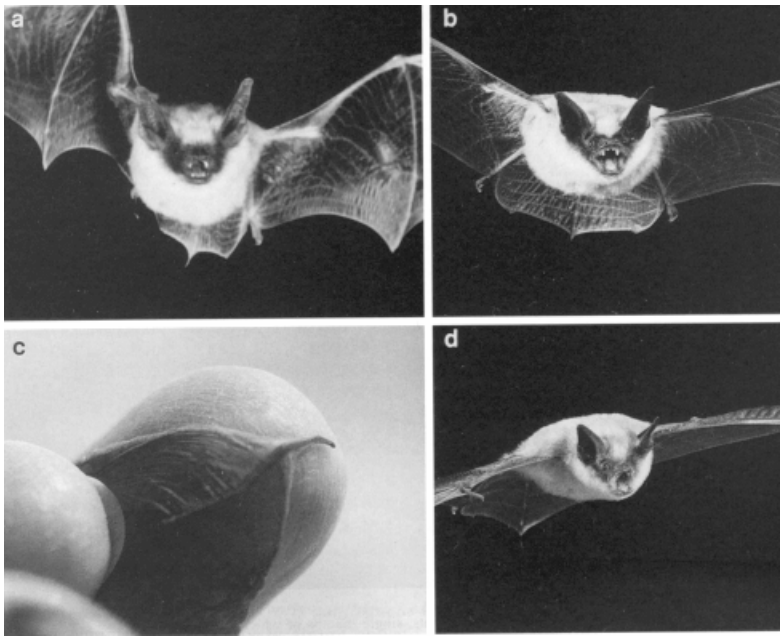


Figure 8

22 a. Forearm usually < 40 mm — 23
b. Forearm usually > 40 mm; conspicuous bare patch between scapulae — *Myotis velifer*

23 a. Forearm 36-41 mm; usually 1 upper premolar (Fig. 9); ear darker than dorsal fur — *Myotis lucifugus*
b. Forearm 32-38 mm; always 2 upper premolars; ear pale, same color as dorsal fur — *Myotis yumanensis*

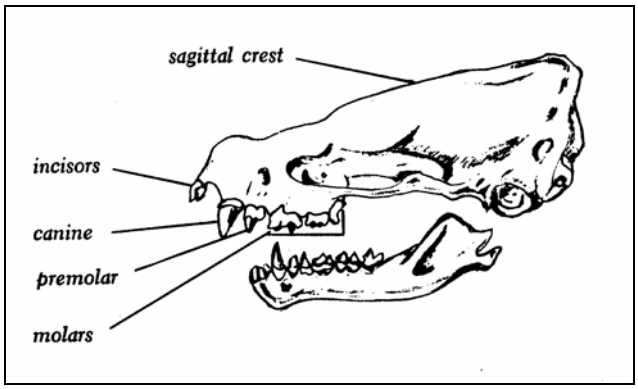


Figure 9

DIAGNOSTIC FEATURES FOR CALIFORNIA AND NEVADA BATS

Prepared by Elizabeth D. Pierson

1. Nose configuration. The presence of a nose-leaf is diagnostic for the Family Phyllostomidae (leaf-nosed bats). This is basically a Central and South American family of bats, but several species make it into the southern U.S. -- two into southern California. Although a few other species have some fleshy modifications of the nostril (e.g., *Corynorhinus townsendii* has horse-shoe shaped protuberances on the nostrils; Antrozous pallidus has a tiny rim of flesh around the nostril, making a pig-like snout), only members of the Family Phyllostomidae have a true leaf-nose.

2. Relationship between the tail and tail membrane. Among North American bats, only the Family Molossidae (free-tailed bats) have about half the tail extending beyond the back edge of the interfemoral (= tail) membrane. In all other species, no more than ca. 2 mm of tail extends beyond the back edge of the interfemoral membrane. In most species it is entirely enclosed within the membrane.

3. Forearm length. The forearm, which is the dominant bone along the leading edge of the wing membrane, is one of the most important features to examine when trying to identify species. In some cases it can be diagnostic; in others it will help narrow the field. The range of forearm lengths reported in the literature should not be taken too literally, however, because: 1) if you are handling an immature animal, its forearm may be smaller than expected; 2) it is not uncommon to find individuals with forearms a bit (1-2 mm) smaller or larger than expected.

4. Size and shape of the tragus. The tragus (a thin, erect, fleshy projection arising from the inner base of the ear) varies in size and shape among species. All *Myotis* species have a very long, pointed tragus, which helps to separate them from look-alike species like *Eptesicus fuscus* or *Pipistrellus hesperus*, both of which have a blunt tragus.

5. Calcar (keeled or unkeeled). The calcar (i.e., heel bone) in bats is frequently elongated, and forms structural support for the connection between the interfemoral membrane and the leg. In some species, the outer edge of the calcar has a keep-shaped fleshy projection. This is a key feature for distinguishing among potentially confusing *Myotis* species (see keys).

6. Size and shape of ear. The size and shape of the ear helps separate groups of bats (e.g., all molossids have rounded forward projecting ears, that are very different from the erect ears of all phyllostomids and vespertilionids), and can be diagnostic for species (e.g., ear length can separate *M. evotis* from all other *Myotis*).

7. Coloration. Some species can be identified immediately based on color patterns of the fur (e.g., no other species has the red to orange fur of *Lasiurus blossevillii*, or the white spots on a black background of *Euderma maculatum*)

QUESTIONS TO ASK YOURSELF FOR IDENTIFYING CALIFORNIA BATS

Prepared by Elizabeth D. Pierson

1. Does it have a leaf nose (Fig. 1)?

Yes = *Choeronycteris mexicana* (very long, narrow rostrum)
Macrotus californicus (relatively blunt rostrum)

No = All others

1. Does it have a free-tail (Fig. 2) ?

Yes = *Eumops perotis* (Forearm 72-82; ears joined at mid-line; Fig. 3)
Nyctinomops femorosaccus (Forearm 44-50; ears joined at mid-line; Fig. 3)
Nyctinomops macrotis (Forearm 58-64; ears joined at mid-line; Fig. 3)
Tadarida brasiliensis (Forearm 36-46; ears not joined at mid-line; Fig. 3)

No = All others

2. Is it red, yellow, black, or frosty?

Yes = *Lasionycteris noctivagans* (black with silver tipped fur)
Lasiurus blossevillii (red)
Lasiurus cinereus (frosty grey with yellow on face)
Lasiurus xanthinus (yellow)
Euderma maculatum (black with white spots; huge pink ears)
No = All others

2. Does it have a keel on its calcar (Fig. 4)?

Yes = *Eptesicus fuscus* (blunt tragus; large size)
Myotis californicus (pointed tragus; FA 29-36; sloped forehead)
Myotis ciliolabrum (pointed tragus; FA 29-36; flat forehead)
Myotis volans (pointed tragus; FA 36-44; hairy armpits; melted ears)
Pipistrellus hesperus (blunt tragus; tiny; black mask)
No = All others

3. Does it have a fringe of hair along the back edge of the tail membrane (Fig. 5)?

Yes = *Myotis thysanodes*
No = All others

4. Does it have a pointed tragus (Fig. 6)?

Yes = *Antrozous pallidus* (blonde; big ears; pig snout)
Plecotus townsendii (huge ears facing forward; horseshoe on nose)
All *Myotis* species (must be distinguished from each other by other features)
No = All others

5. Does it have long ears (> 20 mm in length)?

Yes = *Antrozous pallidus* (fur very blonde; pig snout; ears point to sides)
Euderma maculatum (fur black with white spots; ears huge and pink)
Myotis evotis (fur brown; plain Myotis face; black ears, point to sides;)
Plecotus townsendii (fur brown; horseshoe on nose; ears face forward; can curl them like ram's horns)
No = All others

6. If it is a *Myotis* (i.e., it has a pointed tragus), but does not key out above, then by process of elimination it must be:

Myotis velifer (large *Myotis* - forearm generally > 40, but lacks keeled calcar of *M. volans*, and fringed interfemoral membrane of *M. thysanodes*)
Myotis lucifugus (small *Myotis*; shiny fur, flat forehead)
Myotis yumanensis (small *Myotis*; dull fur; more sloping forehead)

All species can be distinguished with certainty based on external characteristics except for two species pairs. It is **very difficult** to tell *Myotis californicus* from *Myotis ciliolabrum*, and *Myotis lucifugus* from *Myotis yumanensis*. Both these species pairs can generally be distinguished acoustically -- *M. californicus* echolocates at 50 KHz and *M. ciliolabrum* at 40 KHz. *M. yumanensis* is a 50 kHz species and *M. lucifugus* a 40 kHz species.

CHECKLIST FOR IDENTIFICATION OF CALIFORNIA BATS BY FOREARM

Prepared by Elizabeth D. Pierson

SPECIES	Leaf nose	Free tail	Keeled calcar	Tragus	Ear length	FA length	Distinctive Features
Pipistrellus hesperus	No	No	**Yes**	Blunt		25-30	Tiny; black mask; blunt tragus
Myotis californicus	No	No	**Yes**	**Pointed**	15-11	29-36	Keel separates it from lucifugus/yumanensis;
							forehead more sloped than in ciliolabrum
Myotis ciliolabrum	No	No	**Yes**	**Pointed**	13-15	30-36	Keel separates it from lucifugus/yumanensis;
							forehead less sloped than in californicus
Myotis yumanensis	No	No	No	**Pointed**	14-15	32-38	Lack of keel separates it from californicus/ciliolabrum;
							sloped forehead; dull fur
Myotis lucifugus	No	No	No	**Pointed**	14-16	34-41	Lack of keel separates it from californicus/ciliolabrum; flat forehead; shiny fur
Myotis evotis	No	No	No	**Pointed**	22-25	36-41	Distinguish from other Myotis by ear length
Lasiurus blossevillii	No	No	No	Blunt	10-12	36-42	Red fur
Myotis volans	No	No	**Yes**	**Pointed**	8-16	36-44	Short ears w/ "melted plastic" rim; very long tibia; wing
							underside furred to elbow; only large Myotis with keeled calcar
Tadarida brasiliensis	No	**Yes**	No	Blunt		36-46	Ears not joined at mid-line; smaller than all other free-tails
Lasionycteris noctivagans	No	No	No	Blunt	15-16	37-44	Black w/ silver-tip fur; no yellow on face as in L. cinereus
Myotis velifer	No	No	No	**Pointed**	15-12	37-47	Large Myotis; no keel on calcar; no fringe on tail membrane
Plecotus townsendii	No	No	No	**Pointed**	30-39	39-48	Huge, forward facing ears; horseshoe on nose
Myotis thysanodes	No	No	No	**Pointed**	16-20	40-47	Fringed interfemoral membrane
Eptesicus fuscus	No	No	**Yes**	Blunt	12-19	41-52	Large; shiny fur; looks like Myotis except for blunt tragus
Choeronycteris mexicana	**Yes**	No	No		15-18	43-45	Very long pointed rostrum, with nose leaf at tip
Nyctinomops femorosaccus	No	**Yes**		Blunt		44-50	Ears joined at mid-line; smaller than N. macrotis
Lasiurus xanthinus	No	No	No	Blunt		45-48	Very yellow (as opposed to blonde or beige) fur
Antrozous pallidus	No	No	No	**Pointed**	21-37	45-60	Only bat this blonde; big ears; pig snout
Macrotus californicus	**Yes**	No	No		>25	47-55	Prominent nose leaf; two chin pads
Euderma maculatum	No	No	No	Blunt	37-47	48-51	Huge ears; only bat with distinctive white spots
Lasiurus cinereus	No	No	No	Blunt	13-16	54-58	Frosty grey w/ yellow on face and ears
Nyctinomops macrotis	No	**Yes**		Blunt		58-64	Ears joined at mid-line; larger than N. femorosaccus
Eumops perotis	No	**Yes**	No	Blunt		72-82	Largest free-tail bat; ears joined at mid-line

ACOUSTIC BAT SURVEY DATA SHEET

LOCATION:								
LAT (N) º ´	LON (W) º ´		UTM Zone		Easting		Northing	
DATE:								
STATIONARY: Active			Passive					
HABITAT:								
DRIVING:								
Drive Start:								
Drive End:								
HABITAT:								
DRIVING:								
Drive Start:								
Drive End:								
HABITAT:								
Temperature: ºC		Wind:		Sky:				
Sunset: hrs	Sunrise: hrs		Moonrise: hrs		Moonset: hrs			
					Moon (Illumination): %			
Collectors:								

SPECIES		Representative File Name	NOTES

BAT COLLECTION DATA SHEETS

Page of

Location
Latitude (N) o ' Longitude (W) o ' UTM Zone Easting Northing
Date Nets Open hrs Nets Closed hrs # nets # traps (See Reverse) Wind
Cloud Cover
Collectors Sunset hrs Sunrise hrs Moon % Moonrise
hrs Moonset hrs

Time	Species	Sex	TW	Ag	FA	H	Ear	Kee	Tmb	Tl	Wt (g)	Reprod.	V	N/T	Notes

Sex: M = Male; F = Female. TW: Tooth wear – 1 = no wear; 2 = rounded, ¾ = length; 3 = ½ length; 4 = near gum line. Age: A = Adult; YY = Young of year (epiphyses not fused). FA = Forearm length. For Myotis spp.: HF = Hindfoot. Ear = Length from notch. Keel: A = Absent; P = Present. For small-footed myotis spp.: Tmb = Thumb length; Tl = Length of tail tip beyond edge of tail membrane. VS = Vocal signature obtained from hand release. N/T = captured in Net (N) or Trap (T).

Evaluating Projects for Their Impacts to Bats

Public land management agencies are charged to manage for multiple uses, and must evaluate potential environmental impacts of a variety of projects conducted on the lands they manage. The following information is provided to assist resource professionals in the evaluation of potential project impacts to bats and their habitat through a multi-step process.

Step1. Thoroughly review the project proposal. Determine if the project has the potential to impact bats, including direct, indirect, short-term, and long-term impacts to bats or their habitat by asking the following questions:

What is the type and level of disturbance?
How long will the project last?
What are the results of the project and how will they impact the environment?
What time of year will the project be implemented?
Where will it take place and over how large an area?
What types of access (e.g., road building) will be required to implement the project?
What types of habitat will be affected? (e.g., forests and woodlands, riparian areas, and desert washes)
What specific features will be impacted (e.g., water sources, caves and mines, trees, cliffs and talus slopes, bridges, and buildings)
Are there any beneficial impacts?

Step 2. Identify bat species that may be impacted by the project. List them in two separate categories: 1) species known to occur and 2) species that may occur. Use existing data from the area, or if these data are lacking, use the best data possible from areas similar to the project area. Refer to the species distribution maps and profiles in this plan. Then determine what habitat conservation guilds (page 9) these species fall under. The two primary considerations for habitat guilds are roosting habitat and foraging habitat. Assess species' vulnerability by asking the following questions:

What bat species are protected by law?
What bat species are considered at risk in Nevada? (page 11)
What bat species are sensitive to roost disturbance?
What bat species are colonial roosters (i.e., roost in concentrated groups)?
What type of roost(s) might be impacted (e.g., day, night, maternity, hibernacula, lek)?
What species exhibit high roost site fidelity?
What are the known or potential threats to each species?
What is the prey base for each species and how will it be impacted by the project?
What is the probability a species will be affected?
Is the information typical of a given species or a rare occurrence?

It is important to remember that answers to some of these questions may not be known, so use the best knowledge available and consult with the Nevada Department of Wildlife.

Step 3. Identify specific features and habitats that will be impacted by the project that may be used by bats.

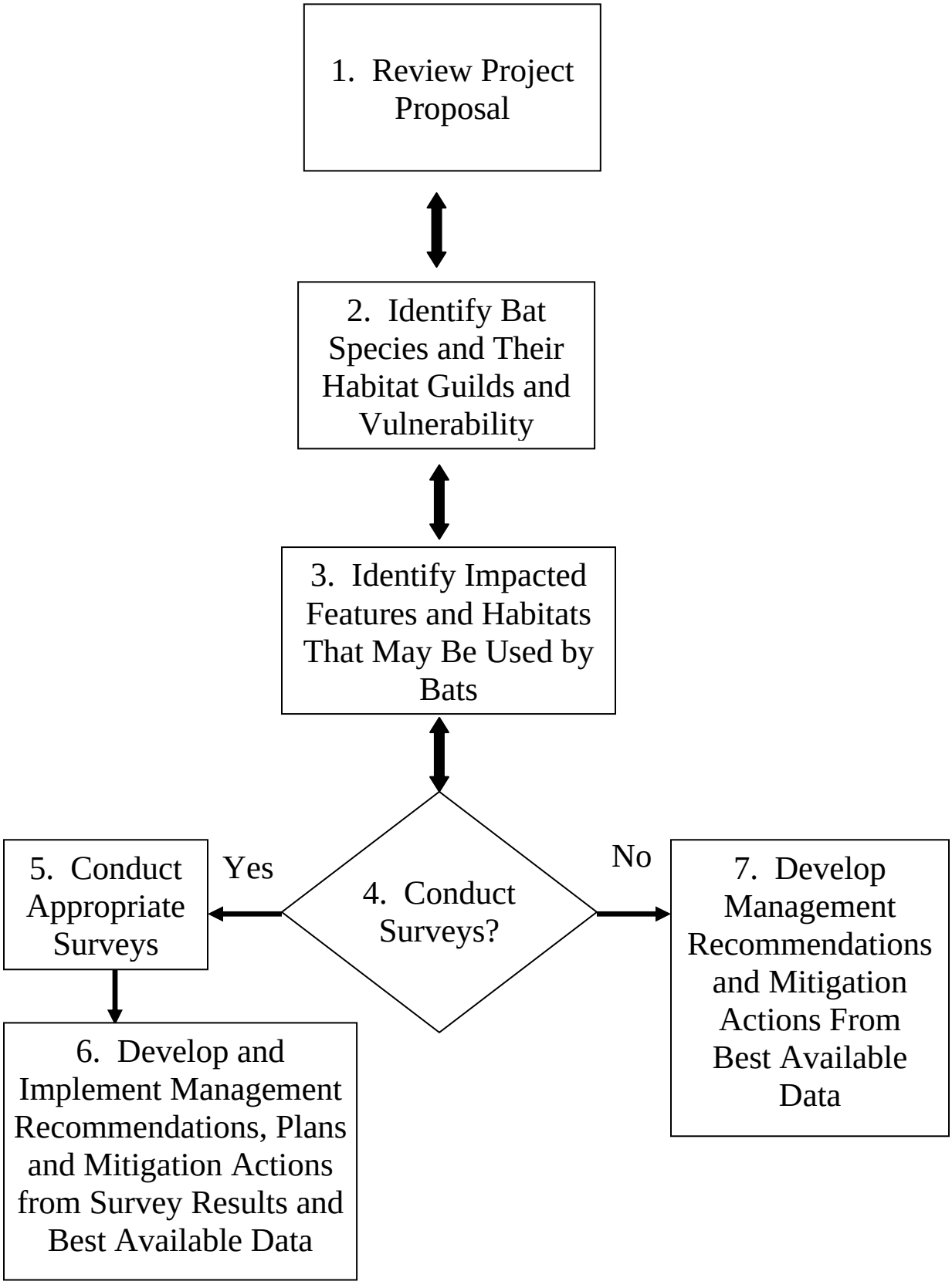
Step 4. Decide whether surveys should be conducted to identify the presence of bats, roost sites, and foraging habitat and what type(s) of surveys should be used (e.g., capture using mist nets or harp traps, acoustic monitoring, radiotelemetry, exit surveys at caves or mines, internal cave or mine surveys,

visual monitoring using vision-enhancing goggles or cameras). Consultation with NDOW biologists and other wildlife professionals specializing in bats may be necessary to assist in deciding if and what kind of surveys should be conducted in order to develop management recommendations and mitigation actions. If surveys are to be conducted proceed to steps 5 and 6. If surveys are not to be conducted proceed to step 7.

Step 5. Conduct Appropriate Surveys

Step 6. Develop specific management recommendations and site-specific mitigation actions based on survey results. If roost sites are found, specific roost site management actions should be developed to protect or mitigate the loss of these critical resources. Again, consultation with NDOW biologists or other wildlife professionals specializing in bats may be necessary to assist in developing these management recommendations and plans and mitigation actions.

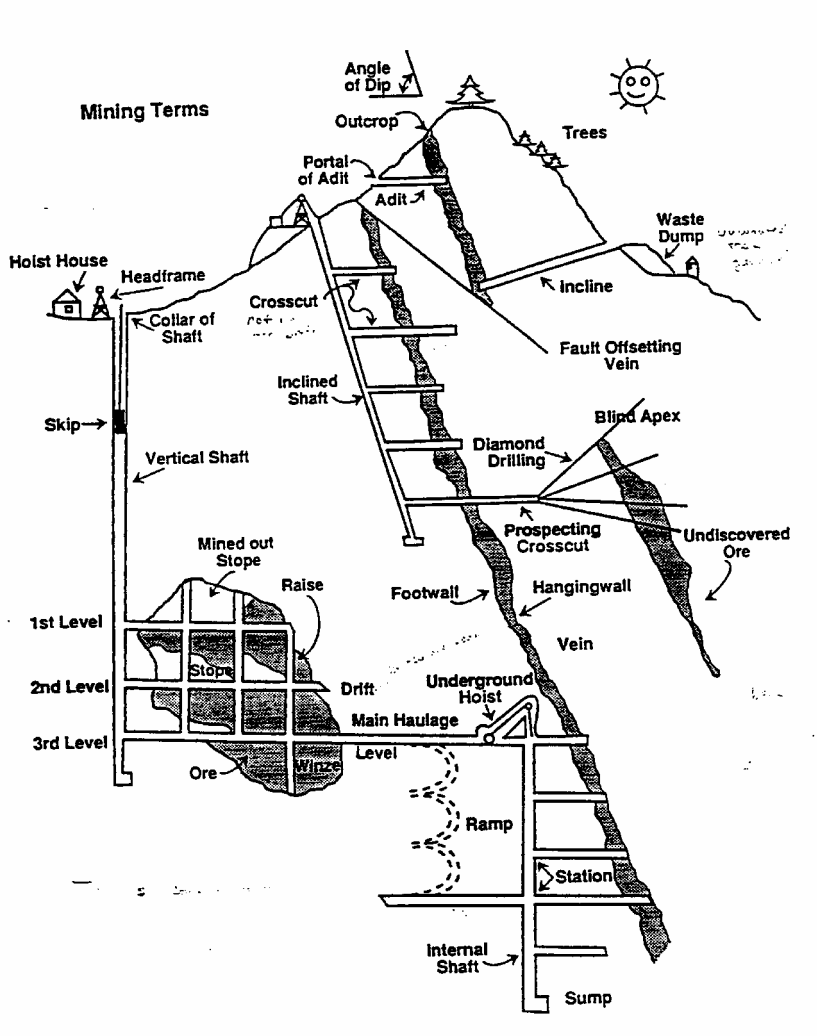
Step 7. Develop management recommendations and site-specific mitigation actions based on best available data from this plan and the literature.


1. Review Project Proposal
2. Identify Bat Species and Their Habitat Guilds and Vulnerability
3. Identify Impacted Features and Habitats That May Be Used by Bats
4. Conduct Surveys?
Yes
No
5. Conduct Appropriate Surveys
6. Develop and Implement Management Recommendations, Plans and Mitigation Actions from Survey Results and Best Available Data
7. Develop Management Recommendations and Mitigation Actions From Best Available Data

Nevada Bat Survey Guidelines

The following guidelines were developed to guide surveyors in the proper evaluation of bat populations and their habitats in Nevada. Qualified bat biologists should conduct surveys. These protocols are not complete nor appropriate for every type of habitat or survey and will likely be refined and modified as new information becomes available.

Mines and Caves



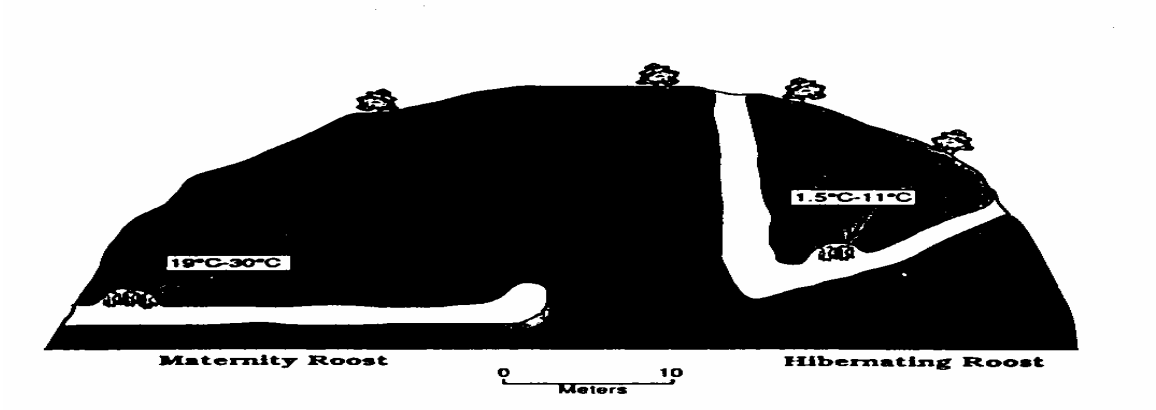
Sherwin et al. (2002) and Altenbach et al. (2002) provide a detailed protocol for the proper evaluation of historical mines as bat habitat. These methods should be used prior to the initiation of any hard closure

(e.g., back-filling, foaming, imploding) policies or renewed mining in historical mining districts. The authors advise great caution when drawing conclusions about the suitability or unsuitability of mine sites

as summer, winter, lek and/or migration bat habitats without the employment of internal survey techniques. Incomplete investigations can lead to bat mortality and/or the destruction of bat habitats. The cited articles are provided in full on subsequent pages and are endorsed by the NBWG.

Maternity roost evaluations are best conducted as external acoustic (although there is the possibility that acoustic surveys may miss some bats, such as Townsend's big-eared bats, which echolocate at a low amplitude) coupled with the use of night vision techniques. External acoustic/night vision surveys should be kept to a minimum and duplication of effort should be avoided whenever possible. The employment of external capture techniques adjacent to cave and mine openings must be done with great care. Capture surveys should only be conducted where a specific need can be demonstrated and must be done no more than once in a three year period (triennial basis). With the exception of emergency situations, the entering of bat maternity roost sites during the maternity season is strongly discouraged as frequent disturbance could cause females to abandon their young.

Internal roost evaluations during the hibernation season should be conducted no more than once every three years (triennial basis) and should only be conducted where a specific need can be articulated (long-term trend site, population decline is suspected, etc.). Duplication of effort must be avoided at these sites. With the exception of emergency situations and scheduled scientific investigations, the entering of bat hibernation roost sites during the hibernation season is strongly discouraged.



For all internal surveys, the use of white light is discouraged. The use of red filtered light is preferred although there is some evidence that bats may be able to see this light. Beams should not be pointed directly at individual bats. Surveys should be expeditious and quiet. If you must talk, do so in a low voice. Do not whisper. Pick up the feet.

Pre-surveys and Determining Survey Methods (prepared by Pat Brown)

I. What is a Pre-survey?

Prior to conducting an internal or external survey, sources of information may be checked to assist in determining the type of survey to perform. A pre-survey does not take the place of a survey, and it is merely an information gathering exercise.

1. Local inquiries

Public - residents in the area

Organizations - State and Federal agencies, Abandoned Mine Lands Programs, Search and Rescue, Mining Companies, Caving Grottos, Boy Scouts, others.

Problems - generally does not provide species-specific information;
may over or underestimate types of use or numbers

2. Historical inquiries

Mine personnel - information may be anecdotal; mine maps may be available but may not show most recent workings or collapses

Agency personnel - information may be too general; mine maps may be available but may not show most recent workings or collapses

Problems - generally does not provide species-specific information;
may over or underestimate types of use or numbers

3. Mine feature information

Number, dimension, location, and description of all entrances (also note airflow, if any, through entrances). Sometimes internal connections are not apparent by an external examination, and at certain seasons and temperatures no air flow may be apparent in multiple entrance mines.

Presence of any obstructions (vegetation, old timbers, trash, etc)

Presence of standing water or evidence of prior flooding

Internal mine features that can sometimes be safely determined from outside, such as depth, side passages, and/or ventilation shafts.

Visual signs of bats (roosting bats, carcasses, guano, or insect parts.) – possibly obtained by shining a light into the cave or mine.

Other wildlife (owls, tortoises, Say's phoebes, etc.) – possibly obtained by shining a light into the cave or mine.

The size of the dump outside of a mine can indicate the internal volume. This may underestimate the volume in cases where more high-grade ore was removed or the entrance is located in a drainage and material has been washed away. Also, some air shafts without dumps may be the primary access point to the mine for bats.

General guideline - Adits less than 10 to 20 feet and shafts less than 25 feet (only if entire shaft is visible and no drifts or connections can be seen) are unlikely habitat

II. Types of Mine Surveys - Choosing a Survey Method

1. External Surveys

Requires numerous observations to identify different seasonal use

Seasonal constraints (no bats exit during winter hibernation) - may decrease effectiveness

Success (or failure) may be influenced by wind, lunar cycle, precipitation, temperature, human presence, or other external factors

Species specific information requires employing capture and/or acoustic detection methods

Minimal safety risks to investigators

Generally requires specialized equipment (infra-red lights, night vision equipment, acoustic detection equipment)

2. Internal Surveys

May be dangerous to surveyor safety and requires extensive training

Can be performed anytime to clarify a particular seasonal use

Generally allows for species specific identification

Requires specialized equipment (mine lamps, gas detector, safety helmet, etc)

Reduces required survey time

Provides information even if no bats are observed (guano, insect parts, etc)

Winter use as hibernacula can only be determined by surveys conducted during the winter, and species of bats that hibernate within very small crevices, such as some Myotis species, may be difficult to detect.

Internal surveys will sometimes elucidate connections of mine workings and identify additional surface openings, so that if an external survey is required, observers can be more effectively positioned.

Guidelines for External Mine Surveys for Bats (prepared by Pat Brown)

1. Arrive at the site at least an hour before dark. If rain or winds of more than 10mph occur, select another night. For some bats species, moon phase may affect bat emergence, while for other species may not matter. Take notes on wind, moon phase, temperature and climatic conditions.

2. Quietly position watchers by all mine entrances, and if possible at least 20 feet from portal. If observers have night vision equipment, face away from the west sky when possible. If they don't have night vision equipment, then face them towards the sunset in order to silhouette exiting bats. Some species (i.e. *Myotis*) may exit before dark, while others (i.e. *Corynorhinus*) may emerge only in total darkness.

3. If using a short-wave IR night vision camera, position the camera so it is at a right angle to the portal in order to more easily distinguish exiting from entering bats.

4. It is important that all the mine openings be surveyed simultaneously. No matter how quiet surveyors try to be, bats sense the presence of "predators" outside the mine and may exit out a different opening then they usually do if available.

5. Some genera, such as *Myotis* and *Pipistrellus* exit before dark, although for large colonies, the exodus may continue after dark. *Corynorhinus* and *Macrotus* typically exit after total darkness. For these species, night vision equipment is essential. Red lights (white light covered with red film) are visible to bats, and may inhibit emergence.

6. To count bats, use 2 finger tallies, one to record exiting bats and one to record entering bats. In maternity colonies, bats frequently exit and re-enter a mine several times before finally leaving to forage. If volant juvenile bats are present, the mothers may circle several times before the young accompany them outside. Some bats, such as *Myotis*, enter a mine at dusk from some external roost, presumably to feed on the moths in mines. In these cases, the net count may underestimate the number of resident bats in a mine. Take notes if you observed more bats entering a mine at the beginning of a count than were leaving (i.e. initially you had a negative net count).

7. Night vision equipment and night shot cameras can be of varying resolution and light gathering capabilities. Unless a full moon is present, even very good equipment benefits by the use of an infrared source aimed into the mine. The infrared light sources built into some night vision equipment has a limited range (less than 15 feet), and are typically limited in use. Additional IR lights are often necessary to aid short-wave night vision cameras.

8. Video tape or watch a mine for an hour after dark or until bats stop exiting. When 2 way bat traffic is present (such as maternity colonies), stop when more bats enter in a 5 minute period than exit.

9. To more accurately determine the bat species and/or reproductive condition, return on another night to set harp traps or mist nets near the entrance. Accurate counts cannot be made if capture activities are carried out near the mine. While watching a mine for the first night, determine the flight pattern of the exiting bats for future trap or net placement.

10. Baseline counts are important for determining population trends, and to measure the success of gating or relocation efforts. Subsequent year counts should be made in the same month and under the same climatic and moon phase if possible. For example, do not compare an exit count in May when pregnant females are present with one in August after the young are fledged. Since births are staggered within a colony and may vary between years, counts should be made before any young could fly or after all the juveniles have fledged. Netting near a colony will help to determine reproductive conditions.

11. Survey protocols may need to be refined in different geographic locations, since the species of bats and their activity patterns may differ in low deserts and high mountains. The time of year will also influence the bat activity (i.e. in the fall more bats may enter a mine than exit for breeding purposes).

12. Monitoring a mine with ultrasonic detection equipment can be useful. Some species of bats (*Corynorhinus* and *Macrotus* especially) emit very faint signals, and can only be detected at close range and if they are facing the microphone. The bats with large eyes (*Macrotus* and *Antrozous*) may not emit sonar signals if adequate ambient light is present. More detailed information on acoustic monitoring is provided in subsequent pages.

13. It is important to remember that bats may not necessarily exit a mine every single night. There may be abundant food and water inside the mine structure, or they may not exit because they can sense human presence outside the structure. A single external survey is in no way to be considered a valid assessment of a mine. External surveys must be performed in repetition across different seasons to more adequately determine the bat use of a mine site. External surveys can not determine the use of a mine as a winter hibernacula.

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METHODS FOR DETERMINING LOCAL MINE CHARACTERISTICS OF IMPORTANCE TO BATS

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Abstract

When attempting to address questions regarding specific characteristics of mines that can be used to predict occupancy by bats, investigators need to identify several important criteria. We propose that the key questions that need to be articulated are: 1) what species is being addressed - - no two species have the same physiological/natural history requirements, 2) what type of use is being investigated (maternity, hibernation, etc.)-- this can greatly impact the conditions that are being sought, 3) what is the spatial scale of interest -- a tremendous amount of variability can be exhibited both within and among populations, 4) what temporal scale is being investigated -- a mine may appear unused for years and even decades, but that does not necessarily indicate that it is not actual habitat, 5) how will occupancy be interpreted -- what does occupancy indicate about roost "quality", and 6) how will habitat be defined -- where the bat roosts in a mine, the mine itself, a mine complex, etc. A decade of research has revealed that bat occupancy of mines is a highly complex issue. While simple explanations of complex phenomena may be attractive for management purposes, there is no accurate list of mine characteristics that can be used to gauge quality of habitat. When individual bats or colonies select roosts, they are most likely selecting for a set of conditions that a roost provides, not selecting for specific roost attributes. These conditions include (but are not limited to) temperature, humidity, protection from predators, density of local roosts, and protection from ambient conditions. Suitable conditions can be realized in mines of all type, structure and configuration. Conversely, local surface effects (such as climate, elevation, aspect, number of openings), may constrain subsurface conditions, making specific characteristics of a given mine irrelevant. Likewise, these same surface conditions may make seemingly unsuitable mines (small, simple workings) excellent habitat. As stated, no template is available against which mines can be compared to infer actual or potential use. Therefore, techniques for identifying constraints and important characteristics of roosts, on a local scale, will be discussed.

Key Words: Bats, abandoned mines, habitat, roosts, habitat selection, variability

Introduction

The use of abandoned mines by bats has become an important issue to the mining industry, management agencies, conservation groups and wildlife biologists. While documentation of bats using abandoned mines as roosts has long been known (Pearson, 1962), it has only been in the past two decades that the management and protection of abandoned mines has become a serious, industry-wide issue. The challenge of locating, identifying, and protecting critical roost locations, while concurrently providing for human safety and ongoing mineral exploration and extraction, is daunting. Techniques associated with

locating (i.e., survey techniques) and protecting (education, signing, gating, etc) roosts are being addressed elsewhere in these proceedings (Altenbach *et al.,* this issue; Brown, *et al.,* this issue). Here we discuss how to identify specific characteristics of abandoned mines that are important to bats.

There is no list of variables that can be used to absolutely gauge the quality of a particular abandoned mine to local bats. In reality, the use of abandoned mines by bats is far too complex to suppose that a "cookbook" approach that lists attributes of all mines, that all bats select for can be effective. At best, sweeping inference about large scale biological processes is inaccurate, at worst, it can cause the implementation of inappropriate management and result in the destruction of the very resources needing protection. Examples of misappropriate extrapolation of data across spatial scales, are the following statements: "bats don't use coal mines," "bats won't use shafts," "mines less than 50' long won't be used by bats." Unfortunately, these statements were used to excuse conducting biological surveys of mines prior to site destruction (through reclamation, renewed mining activity, etc).

When attempting to identify habitat associations of a given species or group of species, it is imperative that the proximate and ultimate constraints of the system be understood (Krebs, 1989). As a general rule, the smaller the geographic range and more simple the natural history of a given organism, the more narrow will be the constraints imposed on the system (Krebs, 1989). The more narrow the constraints, the lower the potential variability, and the more easily definable the habitat associations. For example, habitat associations of the Rocky Mountain Bighorn Sheep *(Ovis canadensis)* are much more easily identified than those of the Great-horned owl *(Bubo virginianus* - Krebs, 1989).

Habitat associations of bats are difficult to define for several reasons. First, the proximate and ultimate constraints on the system are not clearly understood. Second, the natural history of most bats is complex, and in most species is still not well understood. Bats spend a significant amount of time roosting, and the first step in determining habitat affinities is to understand the types of roosts used. Approximately 25 species in the US are known to roost in abandoned mines and 22 of these are considered to be dependent upon abandoned mine workings during at least part of the year (ex. for hibernating - see Bogan, this issue; Harvey, this issue--). The association of these bat species with abandoned mines, coupled with the loss of abandoned mines to reclamation and renewed mining activity make it critical that we understand specific attributes of individual mines that make them suitable or unsuitable to bats.

The Problem

Unfortunately, no data set currently exists from which a model can be generated that can be used to identify specific variables of all abandoned mines that make them suitable to all bats as roosting habitat. It is important to remember that when individual bats or colonies select roosts, they are likely selecting for a set of conditions within a roost and are not selecting for specific roost attributes. Conditions of importance can be realized in mines of all size and configuration. In addition, local surface effects (climate, elevation, aspect, etc), often constrain subsurface conditions, making specific attributes of a given mine irrelevant (See Kurta, this volume).

For example, models of use by Townsend's big-eared bat *(Corynorhinus townsendii)* in northern Utah indicate that this species is distributed independent of internal characteristics of mines. Additionally, they are randomly distributed among available roosts in lower elevations associated with juniper woodlands (Sherwin, *et al.,* 2000b). However, this model does not work beyond the sub-regional level (scale dependent); in addition, this same model may not be applicable across temporal scales (Sherwin, *et al.,* 2000a). Models of roost affinities are both spatially and temporally scale-dependent, and will likely be extremely effective at local scales. However, applying these models to other locations and/or other systems is inappropriate at best (Sherwin, *et al.,* 2000a).

Investigating the Problem

The sensitivity of local models to variation in spatial and temporal scales make it critical that resource managers and researchers collect appropriate data in their system of interest and consider important variables driving selection of roosts at the local level. Due to the inherent complexity of this system, investigators need to clearly define specific problems and objectives of interest. Therefore, we propose that the *a priori* answering of six questions will aid managers and researchers in identifying local mines of importance to bats.

What species is being addressed?
No two species of bats have the same physiological or natural history requirements (Hill and Smith, 1984), therefore, it is essential that researchers clearly identify which species is/are being studied. Merely stating an investigation of roost selection by "bats" supposes that the entire system is static, with all populations of all species driven by the same constraints. In fact, enough variability exists among populations, and across ranges, that even species-level generalizations are rarely accurate (Sherwin, *et al.*, 2000a).

What type of "use" is being investigated?
When discussing selection of abandoned mine roosts by bats, it is imperative that the type of use being discussed is clearly articulated. Types of use include maternity (pre-birthing, birthing, preweaning, weaning, post-weaning), bachelor, mating (lek sites), night roosts, migratory, hibernation, etc. Variables driving selection of roosts differ dramatically depending on the specific type of use being investigated.

What is the spatial scale of interest?
Effects of spatial scale are often ignored when attempting to identify variables of significance to selection of roosts by bats. Spatial scale should be clearly articulated *a priori*, as level of inference is limited to the level of spatial scale of collected data (i.e. data can never be applied at smaller spatial scales). For example, a landscape level study provides no data from which microclimate inference should be made (see Channel and Lomolino, 2000; Sherwin, et al, 2000b; Sherwin, et al., 2000a; Strayer, 1999).

What temporal scale is being investigated?
Temporal scales range from within and among seasons to use of roosts within and among years. Some species exhibit tremendous variability in relative fidelity to specific roosts (Lewis, 1995; Sherwin, et al., 2000a; Sherwin, et al., 2000b). While all scales of temporal investigation are valuable, care must be made when attempting to impose short-term patterns on larger temporal scales. Systems can only be interpreted as simple (black and white-presence/absence) by a single visit. Only through the implementation of multiple surveys, across temporal scales, can accurate resolution of biological processes be achieved. This is particularly important when attempting to investigate more subtle patterns of roost fidelity and complex use of roosts reflecting complex behaviors (e.g., mating, intra/interspecific behaviors).

Temperature is probably the most important feature affecting use of roosts by bats and can be extremely temporally sensitive. The high surface-to-volume ratio of bats increases thermal stress, making activity metabolically costly. To offset these physiological costs, many temperate bat species respond to environmental stressors (decreased ambient temperatures, lowered concentrations of prey, etc.) by entering torpor and/or hibernation. There is an optimal temperature range that individuals seek, at which they minimize energy output, while maintaining some theoretical minimum of physiological activity. Temperatures below this range may induce permanent cellular damage while higher temperatures may result in costly output of energy. Similarly, other seasonal use requires equally complex thermal

requirements (ex. maternity). When attempting to create a thermal profile of internal mine conditions, researchers must be aware of the difference between mean internal temperatures and the variance of internal temperatures. Some species appear to select for stable mean temperatures while others appear to prefer areas with low temperature variance. In addition, resolution of internal temperature profiles can only be achieved through the use of continuous recording devices (data loggers), as temperatures can vary dramatically within a site and can fluctuate tremendously (Figure 1). Point measurements at time of survey are not accurate estimates of internal temperature profile (Sherwin, *et al.,* 2000b - Figure 2). Other potentially significant variables that are temporally sensitive include human disturbance and predation.

What level of biological significance will be attributed to occupancy, and what will occupancy infer about roost quality?

This will vary due to specific natural history requirements and current management status of individual species. For example, maternity sites are often viewed as more significant than bachelor sites. This assumes that constraints on reproductive females (with regards to roost selection) are more pronounced than those imposed on males. In addition, this may vary across a species' range. For example, in Utah, groups of hibernating Townsend's big-eared bats are generally small (1-2 individuals), with groups exceeding 5 individuals considered rare. So in Utah, a gate might be recommended for a mine used by a single individual, whereas this same standard may not be valid in New Mexico where wintering groups tend to be much larger.

How will habitat be defined?

The spatial scale of habitat is critical to the management of abandoned mines. It is vital that habitat be clearly and concisely defined. For example, will a roost be defined as the point of actual interface between the organism and the substrate (i.e. the contact point), the feature of use (i.e. the crack, crevice, rock), the working providing the feature (the drift, stope, etc.), the entire mine (all drifts, stopes, etc), the opening(s) providing access to subterranean workings (many mines include dozens of openings), all mines in a complex (complexes often include hundreds of workings), all complexes in a landscape, etc. The definition of habitat dictates what kind of data will be collected. For example, if habitat is defined as the actual interface of the bat and the mine (point of roosting), only intensive, non-invasive techniques are appropriate to provide data necessary to elucidate selection of micro-climates (i.e. data loggers, continuous video, etc). If habitat is defined as "the mine" - including all openings, less intensive monitoring is necessary, but less resolution is provided. In addition, habitat should not be limited to specific roost attributes (however defined), but should include adjacent vegetative communities and other landscape data, because mines do not exist in a vacuum and selection of roosts can be completely independent of subsurface conditions.

Summary

While the use of abandoned mines by bats is a complex system we do not propose that it is unmanageable. However, it is only through understanding and appreciating the potential variability and reflected complexity of this system that biologically valid data regarding roost affinities of bats can be obtained. If the inherent complexity of this system is ignored and simplistic measures applied, mismanagement will result. By appreciating the potential variability in this system, researchers and managers will collect data applicable to the specific problems being investigated. We propose that by addressing the above questions before initiation of data collection, the likelihood of suitable techniques being applied increases.

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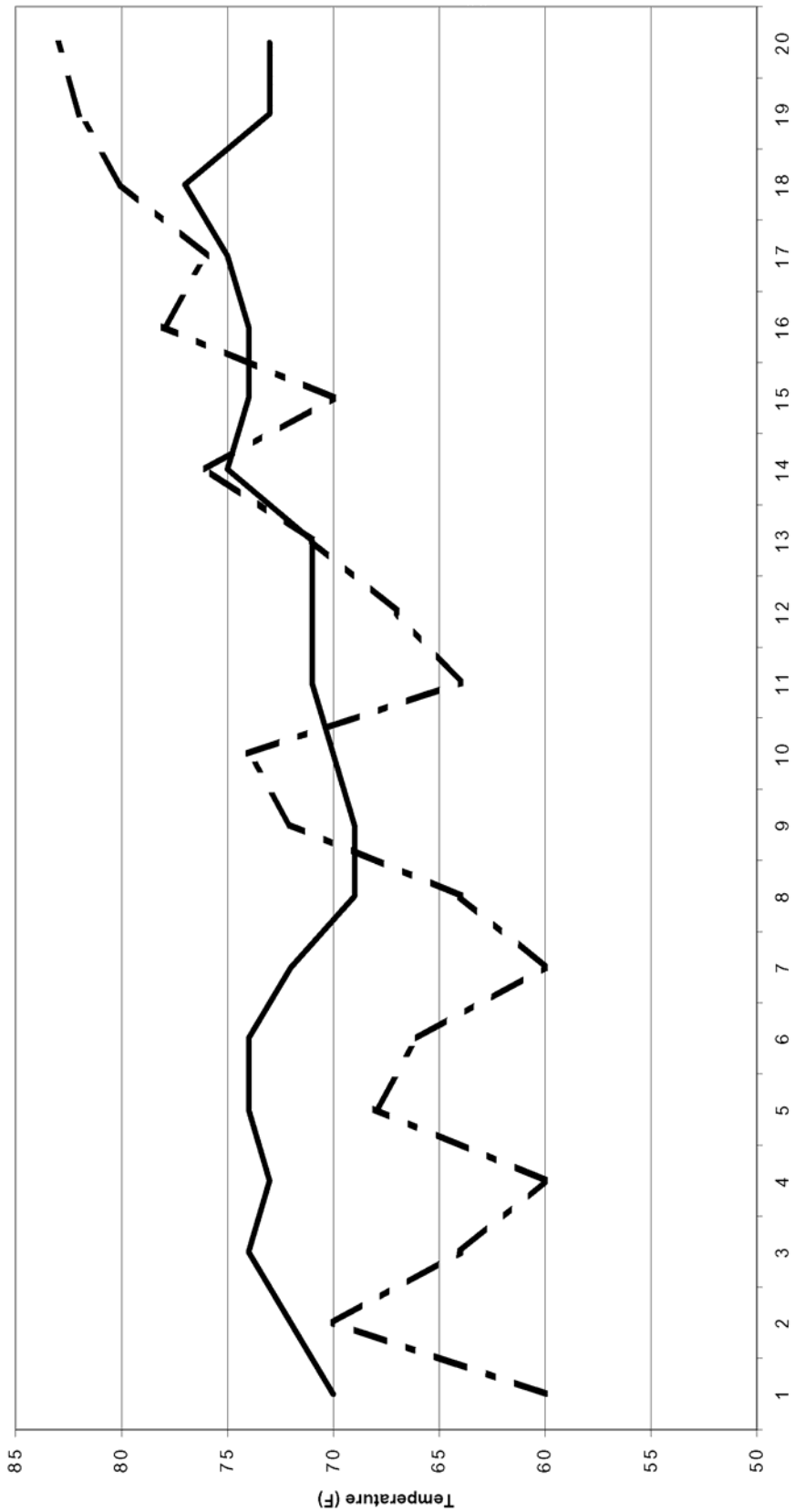

Figure 1. Two data loggers placed two feet apart in the same mine. These data suggest that caution be taken when attempting to create a thermal profile of mine with limited data.

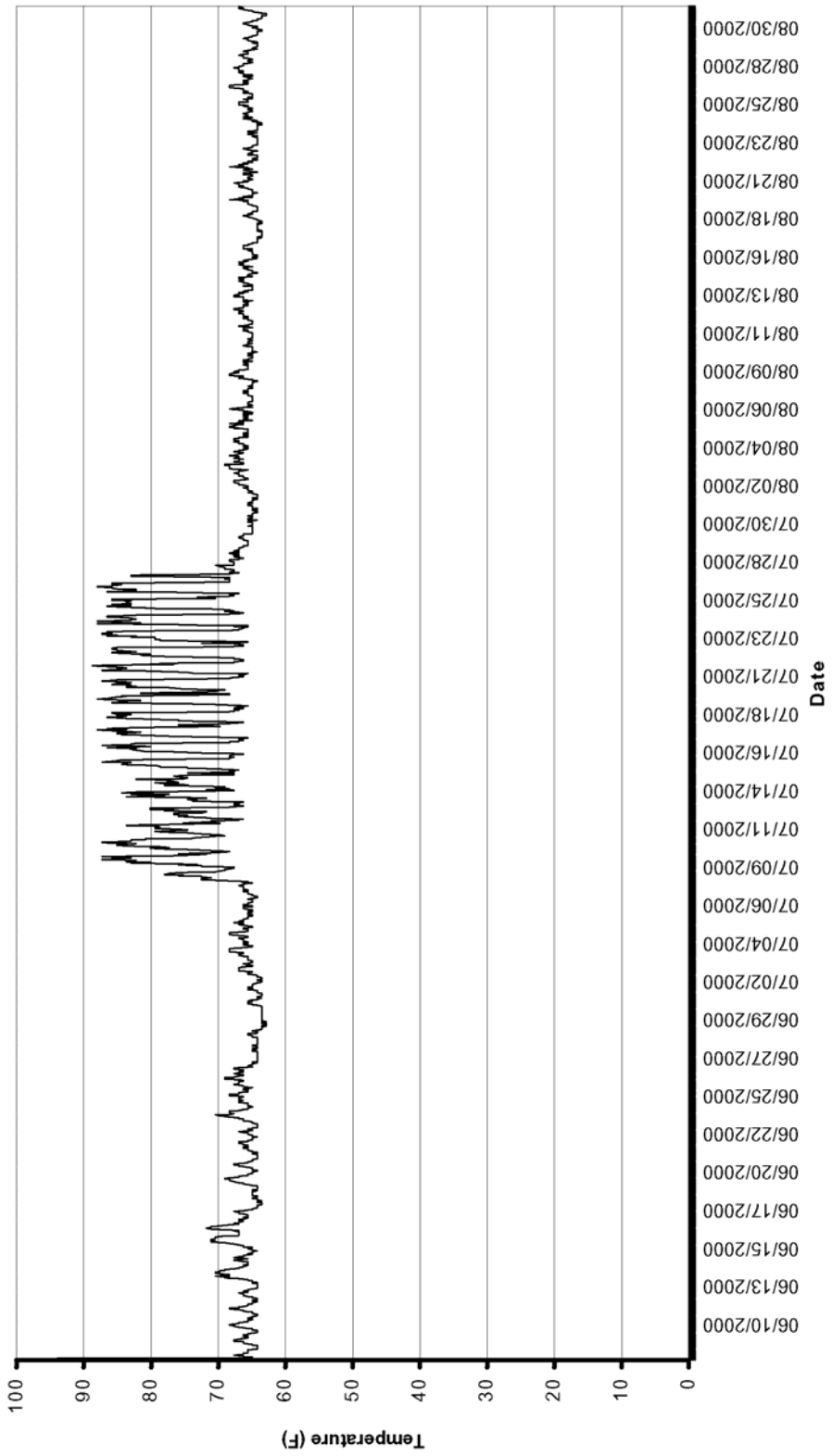

Figure 2. Temperature data collected at the interface of substrate and a maternity colony of Townsend's big-eared bat (*Corynorhinus townsendii*). Maternity colony present between 07-07-2000 and 07-29-2000. Internal micro-climate is regulated by the roosting colony and would appear to be "unsuitable" for a maternity colony based on simplistic sampling of temperatures.

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PRE-MINE CLOSURE BAT SURVEY AND INVENTORY TECHNIQUES

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Abstract

Programs to safeguard abandoned mines have stimulated active programs to evaluate them for wildlife use, particularly use by bats. Experience gained over more than a decade of surveying abandoned mines has demonstrated that we still do not understand enough of the biology of the bat species commonly using abandoned mines, particularly in the West, to accurately predict patterns of use. Surveys are required and experience again has demonstrated that external surveys require specialized equipment and vastly more time than internal surveys. They are virtually incapable of detecting several types of bat use common in the West and those relying on them must be willing to err on the side of excessive caution to keep from making disastrous decisions about destructive closure based on negative survey results. Although internal surveys require proper equipment, experience and training, they are the most reliable and least labor intensive type of survey for evaluating roost quality. Internal surveys provide data from which more informed decisions about appropriate types of closures of mines, particularly those which are complex and have multiple entrances. They can provide critical information for the design of both protective and destructive closures. A small, steadily-growing pool of qualified surveyors makes internal evaluation more feasible and an enlightened attitude on the part of several agencies now permits formal training and experience in abandoned mine entry. In recent times, shaft evaluation has become feasible and can make a considerable contribution to informed closure decisions where shafts comprise a high proportion of abandoned workings. Orders of magnitude more complicated than entry of horizontal workings, specialized equipment and experience is required. Although marginally effective for bat surveys in shafts, relatively new down-hole camera technology has proven itself to be useful in identifying blind shafts and thus eliminating time intensive internal evaluation of working with virtually no bat potential. In districts with large numbers of shafts, this technology has saved hundreds of hours of survey time.

Introduction

As illustrated by Sherwin *et. al*. (this volume), the use of abandoned mines by bats is complex, as is the environment provided by the mines they use. The use of abandoned mines by bats is sensitive to both spatial and temporal scale, making any short term evaluation of abandoned

mines difficult. As more time has been devoted to understanding this system across these scales, the more we have learned, and the better we are able to evaluate and predict the use of mines by bats. Experience over the last decade demonstrates we had only limited understanding of the capabilities, habits and requirements of many species of bats using mines and we still have a great deal to learn. Sherwin *et. al*. (this volume) emphasize that extrapolation from one temporal or spatial scale to another is risky. For example, use of correlative data of internal temperature and specific bat use at one site to judge another abandoned working as suitable or unsuitable, without appropriate survey, courts disastrous decisions. These problems are magnified when this same data is applied across larger spatial or temporal scales.

The following should not be taken as a comprehensive manual on mine evaluation, rather it points out stumbling blocks and factors that can be easily overlooked. It should be used as a starting point and a guide for refinement of a local program. The process of evaluation of abandoned mine use by bats is complicated and must be adjusted to accommodate regional differences, time schedules and availability of expertise. The material presented in this document is only applicable within the framework of the question which is being asked. For example, a biologist wishing to understand local population dynamics would apply these techniques over several years and gradually accumulate a more complete picture. Several years of surveys would be required to resolve patterns exhibited over a multi-year period. In contrast, a local manager who is limited to a single year of survey time, or worse, a single survey, is unlikely to resolve complex spatial and temporal patterns of use. Therefore planning of surveys must consider the least labor intensive and most productive approach and the limitations of the data must be understood prior to its interpretation. Sherwin, et al. (2000a) present effort curves which show average times required to resolve patterns of use in abandoned mines by *Corynorhinus townsendii*. This work emphasizes the need to understand what could be learned from single compared to multiple visits to the same mine workings.

Inventory and Initial Survey

Even though persons doing external surveys (either initial surveys or external bat surveys) are not required to go underground, they should realize that hazards exist on the surface around abandoned mine openings and they should have proper training on these hazards and how to avoid or minimize them. Shafts are very dangerous and surveyors should be specifically trained to approach them. Navo (1995) discusses possible levels of training for personnel as does Perkins and Schommer (1993).

An inventory is simply the location and generation of a map of all mine features in a project (an inactive mine or group of inactive mines scheduled for closure). An initial survey involves description of the mine openings (features) and recording of all information that can be gathered without underground entry including: dimensions, elevation relative to other openings, airflow direction and airflow temperature, obstacles in opening (rocks, vegetation, limbs, trash, portal or headframe timbers), potential hazards, depth of the mine feature (vertical or horizontal) as can be observed from outside, presence of internal complexity (drifts, crosscuts, raises, winzes or stopes) which can be observed from outside, and observations of any wildlife or wildlife sign (excrement, carcasses, staining, discarded parts of insect prey etc.). In some cases mine maps are

available that can provide insight regarding the size, internal configuration and possible interconnection of multiple openings. However, for many older mines, no maps exist, or workings may have been modified subsequent to the creation of maps. The size of the mine dump is not a reliable indicator of internal volume. Typically a large dump indicates a proportionally high volume of internal workings but the inverse may not be true.

Airflow can indicate at least moderate size, multiple openings at different elevation, and complexity, but lack of airflow does not indicate their absence. Airflow in mines with single openings may be caused by barometric pressure changes. In mines with multiple openings at different elevation, airflow will typically change direction with season, and will cease for varying periods at seasonal turnover points. As the outside temperature drops below the mean annual temperature, air will generally exhaust from higher openings. It will exhaust from lower openings as the outside temperature rises above the mean annual temperature. However, there are numerous examples where this does not occur and no explanation of airflow patterns exists.

In an initial survey, a mine can sometimes be eliminated as a possibility for bat habitat. If the rib(side), back (ceiling) and floor of shallow adits and the rib (side) of shallow shafts can be observed to determine that no lateral workings are present (blind) and no sign of wildlife is seen, the mine probably has low potential as bat habitat. If a shaft is flooded above any lateral workings or if an adit is flooded to the back, even periodically, it can be considered to have low potential. However, even in some very shallow mine features, it is sometimes impossible to distinguish depressions from lateral workings. Adits as shallow as 10 ft have been found to have maternity colonies and guano accumulations from them are easily obscured by rock or debris on the floor. Significant colonies of bats have been found in lateral workings, impossible to see from the shaft collar, off of shafts as shallow as 10 ft. Reliable determination from the surface that a shaft is blind can be difficult in shafts as deep as 10 ft, highly unreliable in most down to30 ft and virtually impossible in those deeper than 30 ft. The presence of shaft timbers makes reliable evaluation even more difficult. The use of a current generation of small, light video cameras offers a technological solution to the difficulties of finding lateral workings in shafts without the necessity of shaft entry. This is discussed below in the section on Shaft Evaluation.

Internal or External Surveys

If a mine feature cannot be eliminated as wildlife habitat by an initial survey, an external or internal survey is warranted. A decade of experience by many surveyors has demonstrated that external surveys are generally much more time consuming and can be less reliable for determining some kinds of use than internal surveys. Although this discussion treats external surveys as a fall-back option to be used when restrictions or underground hazards prevent a thorough internal survey, external surveys can provide data that internal surveys cannot. Some of the situations which favor internal surveys include: 1) large, complex underground mines with the possibility of multiple openings, 2) an area has a high number of scattered openings and underground connections are unknown, 3) time to conduct surveys is limited, 4) an understanding of interconnections required to maintain airflow to support significant bat use is needed. Some of the situations which favor external surveys include: 1) accurate counts are required for subsequent establishment of population trends, 2) data is required to establish which

of several entrances are used by bats, 3) situations described below in A. In many situations, detailed knowledge of bat use requires a combination of both internal and external surveys.

Bat Survey Decision Key

The following decision making processes are presented in the form of a dichotomous key where each couplet references additional options. These are presented below and subsequently discussed in greater detail.

A Complete Internal Survey Possible.....B (below)

An internal survey should be conducted until at least a high proportion of the mine is evaluated before declaring that no bats or sign have been encountered. Generally, if bat use in a mine is significant, bats, sign, or both are encountered before the entire mine has been evaluated. It is seldom possible to see all of large and complex mines but it is also seldom necessary. If no evidence of bats has been encountered and the mine has inaccessible levels, large stopes which cannot be accessed, or levels in shafts which cannot be accessed, either the search must be expanded or an external evaluation is required.

A' Complete Internal Survey Not Possible.....G (below)

Reasons in A, hazards prevent or force termination of internal survey, authorities will not permit.

When it is determined that an internal survey is possible the following approach is one that has been used by one of the authors (JSA). Although continuously updated as understanding has changed, it was originally proposed by Altenbach and Milford (1991) and modified by Altenbach (1995, 1999). It has been used, sometimes with modification necessitated by local conditions, for mines in much of the United States.

B Cold Season Survey

No Guano, Sign or Residents.....**F**
Guano or Other Sign.....**C**
Residents.....**E**
Internal Conditions (Water) May
Obscure Sign.....**C**
All, or enough, of the mine cannot be seen.....**G**

C Warm Season Survey

No Residents - Night Roost, Migratory Use,
Specialized Reproductive Behavior,
Undocumented Use.....**D**
Residents.....**E**

D Fall or Spring Survey, Dropping Boards

No Residents, No Additional Sign
(Roost Abandoned, Used Periodically).....**E, F**
Residents, Additional Sign.....**E**

E Decision to Bat Gate Involving Following Questions

Is a threatened or endangered species involved?
Is use significant (determined regionally)?
Are alternative features, used in the same way, nearby?
How feasible is bat-compatible gating?
Will preservation of an abandoned roost provide habitat or mitigate habitat destruction elsewhere?
Is it likely survey missed periodic use?

F Closure By Any Means

Could survey have missed periodic use? Realization of assumptions which must be made if an external survey was applied. If any concern, final internal inspection, mist netting and tarping, or smoke bombing before closure.

G External Survey

By similar accumulation of data, involving observation of activity at openings, then decisions to E, F or G but with realization of the severe limits of external survey. With external survey techniques, significant kinds of use, eg. hibernation, reproductive behavior, migratory stopover, have a high probability of being missed.

Discussion of Internal Surveys (A)

An internal survey, conducted by an experienced bat biologist (experienced with the bat species which are likely involved based on geographic region, and experienced with bats and bat sign in underground workings), also trained and experienced in abandoned mine entry, has proved to be more reliable and less labor intensive than any other survey option. A team approach combining an experienced bat biologist, familiar with the hazards of abandoned mines, with a safety monitor, with a higher level of abandoned mine training and experience is equally appropriate. The safety monitor must make a decision that an internal survey is possible within the limits of safety or must make a decision to abort an internal survey if warranted. It is difficult for a safety monitor to watch every move of someone unfamiliar with basic mine hazards. Their lack of awareness of common and obvious underground hazards (eg. open winzes) invites catastrophic injury or death. A bat biologist, inexperienced in abandoned mine evaluation is often unaware of common hiding places and bat sign in underground workings.

Training and Safety Considerations for Abandoned Underground Mine Entry

As little as ten years ago, agencies and many private entities generally prohibited employees from entry of abandoned underground mines and were hesitant to hire even qualified consultants. Over the last ten years, a gradual and cautious change in attitude about entry of abandoned mine

workings has taken place on the part of some Federal, State and private entities. Formal training on Abandoned Mine Entry by the Bureau of Land Management (Course No.3000-83), Forest Service (National Minerals Training Office, Mine Safety), combined with MSHA New Miner and Annual Underground Refresher training, has provided a small, but growing pool of persons qualified for entry.
Appendix 1 lists some required safety equipment. Internal surveyors should realize it is useless without comprehensive training in its use and limitations. Both are useless without thorough training in, and understanding of, the hazards associated with underground mines.

The subsequent discussion of internal surveys of abandoned or inactive mine workings is provided to illustrate the extent to which such mines are used by bats and the difficulties inherent in assessing that use. This is not a recommendation for others to conduct such surveys nor is it intended as a "how to" description. Abandoned or inactive underground mines are not "safe" to enter and there is no way they can be "made safe". (By the same reasoning cars and airplanes are not safe to ride in and mountains and lakes are not safe to hike or swim in). Persons entering them must understand and accept the associated risks. Anyone entering abandoned underground workings must have appropriate training and experience with the associated hazards and with the ways to minimize them. Caving experience does not qualify someone to enter an underground mine.

Cold Season (Internal) Survey (B)

Hibernating bats typically leave no trace of their presence and mine entry during this period is required to survey for them. Exceptions would include situations where pre-hibernation swarming of large numbers of certain species would be detected by external surveyors. During the initial cold season survey note is made of the layout of the mine and the possibility that parts of the mine cannot be explored. If it is determined that significant parts of a mine cannot be explored and no bats or bat sign is observed, external, warm season evaluation of the mine is required. Careful checking of even tiny cracks or holes in the back and rib is necessary since several species of bats hibernate in such openings. The evaluation of sign (guano, staining, discarded invertebrate parts, remains of dead bats) unless present in very large quantities, requires an experienced eye. An experienced surveyor should be able to identify the guano of many of the species, or at least most of the genera, likely encountered.

If bats are encountered in a cold season survey they must be identified with minimum disturbance. An experienced surveyor should be able to correctly identify any species using an abandoned mine. Mine lamp beams should not be aimed directly at hibernating bats and any attempt at identification should be limited to the minimum time possible. Getting exact counts of clustered or scattered bats does not warrant the disturbance involved. A quick estimate of numbers or of the size of a cluster is adequate and disturbance is kept at a minimum.

The above descriptions emphasize the necessity for experience on the part of an underground surveyor. Only an experienced surveyor is likely to find the sign indicative of use by all but very large numbers of bats, and bats which may use mine workings in an unobvious way may be

overlooked. Highly experienced underground explorers with no bat experience (eg. miners, geologists) are notorious for completely missing obvious sign and conspicuous bats.

Warm Season (Internal) Survey (C)

Warm season generally means at a time when bats are active and flying in and out on a regular basis. The exact timing of these surveys will vary geographically and with yearly variations of local climactic conditions. For example, an unusually cold or prolonged Spring may cause a delay of a month in maternity activity. Consultation with local bat biologists is necessary to time warm season surveys. Maternity colonies may occupy one roost before delivery of pups, another for delivery, and a third after the pups are volant. This complexity must be considered in the timing of warm season evaluation.

Internal surveys during warm season are conducted with extreme care. Many species of bats are intolerant of disturbance at a roost site, especially during the time they are having and caring for pups. Disturbance can easily cause relocation of a colony and worse, mortality of pups (Mohr1972, Humphrey and Kunz 1976). A mine is approached, entered and explored quietly during a warm season survey. Serious disturbance of alert bats in order to make identifications or counts is not warranted. If bats cannot be identified, or if an approximate count is not possible, without disturbing them, external evaluation involving capture or bat detectors and experienced interpretation is in order.

If no bats are found in residence, guano may contain discarded invertebrate appendages and wings that indicate night roosting. If night roosting is suspected, the mine is again entered at night to observe the species and numbers involved. The portal can be monitored with a bat detector or individuals can be captured with mist nets or harp traps. Bats are seldom encountered during an internal survey in mines used as migratory stopover roosts and identification of the species typically involves a careful search for carcasses which can then be identified. Repeated visits to the mine in the time period when migration is thought to occur makes encountering and identification of the residents more likely. Material placed on the floor where guano accumulation occurs (dropping boards) can resolve the time and amount of guano deposition. Recent discovery of mines used entirely for complex reproductive behavior (Brown, 1999) demonstrate highly significant, periodic use that can be difficult to resolve. Repeated external and internal observation was required to clarify this highly significant use after evidence was noted on an internal survey.

Shaft Evaluation

In many mining districts, shafts are common and may constitute a high proportion of the abandoned workings. In localities in many Western States, a high proportion are not flooded and many provide bat habitat. Because of the greater difficulties involved, many private interests and government reclamation programs have not been evaluating shafts as potential habitat prior to closure. Although sometimes sealed with non-destructive closures (ex., rebar grates), typically because of historic preservation requirements, most have been close destructively without evaluation or consideration of habitat potential. A notable exception is the Abandoned Mine

Lands program in New Mexico where shafts have been evaluated and bat compatible closures have constructed if appropriate. Ten years of extensive experience evaluating shafts (over 2000) in New Mexico, California, Nevada, Utah, Minnesota, and Texas by the authors, has

demonstrated that bats readily use them in all of the ways that horizontal workings are used, and the incidence of bat use of shafts is actually higher than in horizontal workings (Altenbach, et al., In Prep).

Lateral workings are notoriously difficult to detect in shafts and this is compounded by shaft timbering. A second issue is that even though internal shaft evaluation can be done safely, it is an order of magnitude more difficult and time consuming than horizontal mine evaluation because of the highly specialized equipment required to compensate for the higher risks. It requires more experience and is generally not recommended unless a specialist is available. The use of vertical climbing techniques is extremely dangerous for shaft evaluation because of the probability of material falling from the collar or rib. Surveyors using climbing techniques to access vertical workings are reckless, and jeopardize a cautious acceptance of internal mine evaluation procedures!

Use of down-the-hole video cameras, hard-wired to a surface viewing screen, has proved an effective tool to determine if a shaft is shallow and blind and thus does not require time consuming additional evaluation. This technique can also identify shafts that have one or more levels where bat use is possible and internal evaluation or conservative assumptions about use warranted. Without internal evaluation, this information would make a bat compatible closure amore reasonable alternative than if the internal complexity remained a mystery.

This technique is not a substitute for internal evaluation of shafts with lateral workings, deep shafts, or timbered shafts where a bat, or bat sign is probably not visible to the video camera. If internal evaluation is not possible in these shafts, it must be assumed that at least appropriate habitat for a variety of bat use exists and the mine feature should be surveyed externally. Highly significant hibernation sites for several species have been found to depths of nearly 3000 ft and maternity and bachelor colonies have been discovered at depths of over 400 ft. In addition, even blind shafts (without lateral workings) can trap cold air providing ideal hibernation sites for bats. Other shafts are warmed at depth, perhaps by geothermal heating, and provide warm temperatures ideal for other kinds of use.

Discussion of External Surveys (G)

External surveys require experienced personnel and a larger number of person-hours than internal surveys. Specialized equipment which is vital for effective external surveys can be costly, eg. night vision and sophisticated acoustic monitoring equipment, and can require extensive experience to use properly, eg. acoustic monitoring equipment. If an external survey is the only option, techniques are discussed by Navo (1995), Navo et. al. (1995) and Tuttle and Taylor (1994). Rainey (1995) provides an excellent overview of equipment, and references, to assist external surveying.

Applications
External survey techniques are suited for resolving warm season use (maternity or bachelor colonies) where exit or entry flights occur nightly over an extended period. Pre-hibernation swarming typified by large colonies of *Corynorhinus townsendii* and *Myotis lucifugus* may be

readily detected if the timing of these events is predictable in a given locality. If these types of use are expected, external surveys may be appropriately timed and implemented to detect them. External surveys can only provide positive data, so absence of evidence should not be interpreted as evidence of absence. Uses such as migratory stopover, short-term responses to climatic changes, use in cold season by small numbers of bats or by bats which do not swarm are difficult o detect. In addition, external techniques are not reliable for resolving events which happen inside a mine, such as reproductive behavior. Data from an external survey cannot be applied across temporal scales and inference cannot be made about past or potential future use.

External surveys are particularly useful when combined with internal surveys at large, complex mines. Some bats (eg. *Antrozous* and some species of *Myotis* and *Pipistrellus*) are very secretive and are easily missed by experienced internal surveyors. If no bat use is detected in a large mine and it is clear that many parts of the mine are not accessible for close evaluation, an external survey of entrances in warm season may be appropriate.

Timing and Implementation
The timing of surveys is critical and depends upon the seasonal changes in bat activity typical of the region in question. Publications on the biology of species that might be in a particular area, as well as consultation with local bat biologists, provide a good starting point for planning the timing of external surveys.

Surveys should be conducted on nights without rain or strong wind, by observers stationed at least 15 ft off to the sides of the mine opening. Setup must be kept quiet be completed at least 30minutes before sunset. Although red lights have been recommended for external surveys, recent evidence suggests bats may be more sensitive to red light than previously thought. After bats can no longer be seen silhouetted against an evening sky, night vision or InfraRed (IR) video camera equipment can be used to observe a mine opening. Observations must be maintained for at least2 hours after sunset. Bats often prefer specific entrances of multi-entrance mine complexes and disturbance by surveyors at this entrance is likely to cause use of an alternate. Even when surveyors attempt to be quiet, a large body of evidence suggests that bats are likely to be aware of their presence. Therefore, all entrances in a particular complex should be surveyed on the same night.

Equipment
The technology for remote, data logging, acoustic or proximity detector monitoring of mine openings has grown over the last decade. Rainey (1995) gives an overview of some examples but the availability of relatively inexpensive video cameras has revolutionized the field. These small cameras with highly sensitive IR detection can record bat activity at mine openings at distances of well over 50 ft. Unattended cameras, set to actuate at predetermined times, can collect data at

as many mine openings as a surveyor has cameras. At one sixth the cost of high resolution night vision devices, the external survey capabilities of a single surveyor is increased enormously. An added benefit is that a carefully positioned, unmanned camera will be less likely to cause disturbance and use of alternate mine opening by bats. An IR video camera, coupled with a sophisticated acoustic monitoring system, provides the capability of accurate timing and resolution of activity with improved species identification.

External Capture Survey
If active bats cannot be identified during an internal or external survey, or if determination of sex or reproductive status is required, capture of some individuals for close examination may be warranted. Persons conducting capture surveys must be capable of field identification, rabies immunized and have necessary state and/or federal collecting permits. The help of local bat biologists, experienced in the use of capture devices to minimize injury to bats, and familiar with handling of local species is appropriate. Setup of mist nets or harp traps is completed at least 30minutes before sunset and is done as quietly as possible. Nets or traps (with someone in attendance at all times) are left up at least two hours after sunset or later if there is a possibility that the mine is used as a night roost. After enough bats have been caught for identification and released, the capture devices are taken down to minimize disturbance.

Decision to Install Bat Compatible Closure (E)

Significance
If a threatened or endangered species is using a mine the decision to use some type of bat compatible closure is clear but must involve consultation with appropriate State and or Federal authorities. Presence of a Species of Concern, formerly a USFWS Category II, might be more significant than species not so listed. The question of significant use is difficult as it is dependant on location and community structure. For example a single, hibernating individual of one species might not be significant in one part of its range but would be in another. Variability in the use of roosts within a species' range makes it impossible to create range wide rules about significance. In some regions single hibernating individuals in small, scattered mines are typical, in others, small to large groups are typical. Input from local bat biologists is necessary to evaluate numbers and conditions of use in the light of comparison with other local populations or trends in population size. Significance must also be weighted against the presence or absence of a comparable mine feature or protected natural roost site, used in the same way, being nearby. All scenarios must be weighed against the complexity, feasibility, cost and reliability of such closures.

A maternity or bachelor colony of any species is significant and cause for installation of bat compatible closure. The use of a mine by bats in any way not documented or not understood should be considered highly significant unless it can be demonstrated otherwise. All closures but must be weighed against involved costs, feasibility and availability of comparable, more easily gated features nearby.

Another complicating factor is the movement between roost sites over seasons or even years. Maternity colonies of some species such as *Corynorhinus townsendii* routinely move among

available abandoned mines over the course of gestation, birth, growth and maturation of the pups(Sherwin, et al., 2000b). Before a site is declared abandoned, additional evaluation over at least a year to check for fresh sign, or bats, is prudent.

Timing of Mine Closure (E, F)

The selection of appropriate "time windows" for non-bat-compatible closure must minimize the chance that unknown residents will be trapped inside. Installation of bat-compatible closures must likewise be timed to minimize disturbance of residents. These time windows will vary with the type of use, the species present and the region of the country. Closure activities need to be coordinated with the help of local bat biologists.

Conclusions

When the systematic evaluation of bat use in abandoned mines was undertaken on a near national scale a decade ago, it was hoped that correlations between external characteristics of an abandoned mine and its use by bats could be established. This would at best eliminate the need for internal evaluation and at least simplify the survey process. Tuttle and Stevenson (1978) and Tuttle and Taylor (1994) have suggested that if the internal configuration, configuration of openings and mean annual surface temperature is known, internal temperature conditions, and thus suitability for bat occupancy, can be predicted. They infer, perhaps correctly, that mines with multiple openings and complex internal configuration are likely to have variations of internal conditions that maximize the chances parts will be suitable to bat use. However, as Sherwin *et. al* (this volume) have shown, correlations of use and temperature, especially microenvironmental temperature, have been difficult to establish. Small, uncomplicated mine workings can have large and significant use by bats. Even if we could make broad spatial and temporal scale predictions about temperature and use, we are still unable to predict internal temperature itself.

The size, internal configuration and number and configuration of openings of most mines is nearly impossible to determine by external evaluation. In some instances, mine maps may be available but our experience shows that these are seldom complete. The quantity of waste rock at a portal is not necessarily an indicator of internal volume. Ventilation openings, common in many mines (Hardesty, 1988), sometimes have no waste rock around them, are often small and many times inconspicuous. Where there are several mines in a restricted area, the configuration of surface openings gives virtually no indication of how, or if, the internal workings connect. Airflow measurements must be made at all openings to even guess at internal configuration and a variety of conditions can influence airflow. Strong airflow at a mine portal suggests that there are other openings but lack of airflow does not indicate their absence. In addition, the airflow patterns of some mines as yet cannot be explained. Similar mines, close to each other, can have very different internal temperatures because of geothermal heating or for unknown reasons.

For the majority of abandoned mine sites no mean annual temperature data exists. Often a town for which temperature data is available is at a different altitude than a mine site only a few miles away and has different surface temperature conditions.

Bat biologists have a great deal to learn about even basic bat biology. This data has been accumulating for many years and a great deal is known about many species but even for very common species, large gaps exist. For example, *Myotis yumanensis* is an extremely common

warm season resident of the Rio Grande and Pecos drainage in New Mexico but until a migratory stopover roost of this species was discovered in a deep shaft in the mountains of central New Mexico, **nothing** was known of the non-warm season activity of this species in New Mexico. In June the internal temperature of this mine is several degrees cooler than any known maternity roost site of any bat found in New Mexico. However, in June female *Myotis thysanodes* with near term fetuses were found in torpor in these workings. A possible hypothesis is that the animals may be driving embryonic diapause with this behavior. Both of these examples of bat use were considered highly significant and justified bat-compatible closure. We are continually surprised by finding bats at great depth in shafts in both warm season and cold season.

Until comprehensive research provides a measure of predictability, we believe the systematic evaluation of all mine features scheduled for closure provides the only possibility for combination of the goals of securing abandoned mines for human safety and protecting bats that may rely on them. We have to consider that almost any mine can be potential habitat for bats and the only way to know is to look.

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Appendix 1: Safety Equipment for Abandoned Mine Entry

The **MINIMUM** safety equipment required for underground work includes: Approved hard hat with chin strap, steel-toed boots, three sources of MSHA-approved light, multi-gas detector with at least O_2, CO, Combustible Gas capability, O_2 detector with remote sensor head. Additional equipment such as a respirator with filters is useful in some situations where particulates, radioactive particles or pathogens may be a factor. If any vertical climbing is required, the appropriate, specialized equipment and training (as well as practice) in its use is obviously vital. Vertical climbing in abandoned mines, especially in shafts, is an order of magnitude more dangerous than typical vertical mountaineering practice and is warranted under only rare circumstances. Training and supervised experience with this safety equipment, as well as thorough understanding of the circumstances and conditions which necessitate its use, is vital.

Inventory and Capturing Bats at Water Sources

Many survey techniques can be employed at water sources. Population trends and changes in species composition over time can be evaluated at these sites using acoustic, night vision, infrared camera and capture techniques. A statewide survey grid is proposed in the Water Source section of this volume.

General Discussion of Capture and Acoustic Surveys

In order to obtain the most thorough inventory of bats, it is necessary to use as many techniques as possible. If time permits, a thorough search for available roosts (e.g. tree snags, caves, abandoned mines, buildings, bridges) should be conducted. Concomitantly, other features known or suspected to be attractants to bats should be evaluated (e.g., troughs, ponds, streams, riparian corridors, springs). This presurvey information may be accomplished by examination of detailed topographic maps, consultation with local resource agencies, and conversation with local residents or others familiar with the area. There is also no substitute for a preliminary trip to a site to gain personal knowledge of the existing variability in terrain and habitat mosaic.

Standard capture methods can be used at any designated attractive feature. This can entail a variety of equipment and ingenuity but usually consists of a combination of mist nets and double frame harp traps. Some situations are best suited for one or the other, but combined use can yield better success because of differential trap success among bat species. Depending on the type and configuration of a roost site, other types of capture devices may be more effective. A review of capture devices is given in Kunz and Kurta (1988).

Capture techniques provide animals in hand, which is often thought to provide definitive identification. In truth, this is not necessarily the case. Some species can be very difficult to identify, particularly in the field. In Nevada, two sets of species are difficult to distinguish in hand (California myotis from western small-footed Myotis and Yuma myotis from little brown bat). It is not uncommon for animals to be processed, identified and released during the night. Performing the necessary measurements and assessment of coloration can be difficult on a live animal in artificial light. Taking proper and repeated measurements on a live animal requires experience. The accompanying form data sheet for capture surveys provides a template for ensuring that critical measurements are obtained for the species identification. This form should be used to provide the minimum necessary for a competent capture survey. Voucher specimens should be taken for unusual captures (e.g., range extensions), animals of questionable identity, or those from areas with no previous surveys. Such specimens must be housed at a recognized, actively curated museum. Under no circumstances, can voucher specimen numbers exceed specifications on one's Scientific Collection Permit.

Acoustic survey methods provide a powerful tool for obtaining an inventory of bats as well as more detailed information on habitat use and activity patterns. Equal to its power is the ability for this method to be misused. As with any survey method, if it is done correctly, the results will accurately reflect existing conditions. The reverse can also be true. The following protocol entails the use of the Anabat detector and analysis system (Titley Electronics, Ballina, NSW, Australia). The Anabat provides the ability to monitor in real time, allows low memory storage of all detected bat activity, provides digital storage on a computer hard drive, and has the ability to examine, edit and measure all calls in a sequence simultaneously. The small digital files are easily archived and provide a permanent voucher record. Thus, any errors in identification can be determined and corrected as new information/knowledge becomes available. There are other detectors available commercially.

The first question for any proposed survey is: "How many sampling periods should be surveyed?". The answer is as many as possible. Multi-season sampling is important for understanding the broad dynamics of species composition. Bats are highly mobile and exhibit a wide range of use strategies throughout the

year. At a minimum, a location should be examined during each season. Is a single night sufficient? Not usually. Ample evidence exists to document that nightly patterns of activity can vary significantly. This is true for the number of individuals active within a species as well as for species composition. Examining multiple, consecutive nights of data provide a much more accurate indication of bat use. A minimum of three consecutive nights for each sampling period is recommended. Capture devices should be re-arranged from night to night as bats learn to avoid new obstacles encountered. Acoustic devices are not intrusive and can be left in place each night.

Acoustic Surveys (Active vs. Passive)

Acoustic sampling can be conducted actively (observer present) or passively (observer absent). Data recording should be directly to either a laptop computer or a Compact Flash card depending upon acoustic equipment used, and not to a tape recorder. Cassette tapes introduce extraneous noise and frequency determination is affected by change in battery voltage. Additionally, important information, such as exact time of activity, can be lost. Both active and passive methods are important and should be employed simultaneously where feasible. Without an external battery source, duration of active monitoring is limited to the life of the internal battery, usually two to three hours. It is desirable to actively monitor the general area being sampled by one or more passive units. This allows the observer the opportunity to get first hand knowledge of existing conditions and activity, which aids in interpreting and identifying vocalizations. Observing calls during the monitoring process, noting where bat activity is occurring, and getting visual feedback through spotlighting provide needed context critical to the identification of some species. Detailed methods for recording vocalizations, visual identification and interpretation of recorded vocalizations can be found in the Anabat User's Manual (Corben and O'Farrell; available at www.mammalogist.org). O'Farrell et al., (1999) present methods for identification as well.

Passive acoustic monitoring may be done several ways. An Anabat laptop setup can be set in monitor mode (automatic record), the detector propped up to monitor the desired space, and then left to record. This is often done during short periods when capture devices must be checked and captured bats processed. Simply leaving the equipment exposed to the elements and passing animals does have inherent risks. An ideal compact and weatherproof setup contains a detector, CF ZCAIM, and an external battery for long-term use. These units are portable and easily deployed in remote situations. To use this setup to monitor a location on more of a permanent basis, the addition of a solar panel is all that is needed. Multiple units can be operated simultaneously in order to monitor different habitats or other features geographically isolated from each other. Passive systems can generate huge quantities of data, which can present a problem when it comes time to review and identify species composition and activity. Improper detector placement and/or sensitivity settings can result in files full of echo and other noise (insects, etc.) that can interfere with the identification process.

Acoustic Surveys (Fixed-Point vs. Mobile)

Acoustic surveys can be conducted at fixed points or they can be mobile. Fixed points can yield detailed information about a particular habitat feature. Both active and passive monitoring is appropriate. To be most effective, fixed points should be selected randomly. The same type of decision-making for capture devices should be applied to fixed-point acoustic sampling. Because the volume of space actually sampled by the equipment is finite, it is imperative that locations be selected where bats should be expected to occur (e.g., water sources, riparian corridors, suspected flyways, habitat edges, and roosting sites). As with capture devices, proper placement of the acoustic device will maximize the quantity and quality of data obtained.

The Anabat detector is relatively directional with an apparent cone of reception of approximately 45 degrees. In reality, the envelope of detection is irregular and lobed within those 45 degrees. During active monitoring, it is best to pass the detector in a slow arc while searching for bats. Once detected,

then the echolocation calls should be followed as best as possible. This maximizes the number of calls obtained in a sequence.

Orientation of a passive setup is critical to obtaining useful data (Patriquin et al. 2003). It is necessary to place the unit to sample the greatest concentration of bat activity. For a small water source, such as a tank or trough, the microphone should be oriented toward the space above the water and placed at least 15 m away. Although it is best to know one's detector and the nuances of its sensitivity setting, a good default sensitivity setting is six to seven. At a water source, a high concentration of bat activity can be expected. This can produce an acoustically cluttered environment similar to a single individual flying near vegetation or a rock face. Placing the detector a minimum of 15 m from such clutter helps reduce the amount of echo and other extraneous noise. At streams, vegetation edges, riparian corridors, or other linear habitats, place the unit to sample the long axis (parallel to the edge). Most activity will occur parallel to the edge, thus bats will be within the detection envelope longer than if the unit were oriented perpendicular to the edge.

Acoustic monitoring at roost sites can be useful but caution needs to be exercised. Any activity around a roost entrance involves a certain amount of clutter (physical or the presence of other bats). In some cases, the calls of bats exiting a roost are similar to those immediately given during hand release and bear no resemblance to calls given in free flight in the open. Thus, they are of no value in identifying species present. Active monitoring at a roost allows visual feedback and the ability to assess quality of calls. Immediate adjustment in sensitivity and/or changing position in relation to the entrance can be made. Passive monitoring does not allow this adjustment. Therefore, it is imperative to place the unit a sufficient distance away from the entrance (minimum of 15 m) to minimize clutter interference. The greater the amount of physical clutter around the entrance to a roost, the greater the distance the passive unit should be placed away from the entrance.

In clutter, bat calls tend to be reduced in frequency range and duration. Thus, much of the diagnostic structure necessary for species identification is lost. This is particularly significant when dealing with species that can be confused. For example, California myotis and Yuma myotis are both 50 kHz bats (characteristic frequency approximately 50 kilohertz). In free flight and away from clutter, these bats are readily distinguishable. However, in clutter their vocal signatures are virtually identical. They can be found roosting in the same structures, which can compound the problem. Capture methods would need to be used to assist in determining whether both species are present. If clutter cannot be avoided, it is best to limit identification to a group of species rather than risk misidentification.

Simply because bats are recorded at a roost, specifically a mine or cave entrance, does not mean the bats are using the structure. Likewise, simply because bats are not recorded at an entrance does not mean that bats are not using the structure (e.g., there may be unknown and/or multiple entrances). Also, actively monitoring near an entrance can inhibit bats from exiting the structure. This is particularly true for the Townsend's big-eared bat. Placing a passive unit can circumvent this problem, although a bat flying overhead could be perceived as using the entrance. Visual verification is sometimes necessary. Placement of a camcorder with infrared capabilities (e.g., Sony DCR-TRV 120 with Nightshot and hot shoe IR light source) focused on the entrance will verify specific ingress or egress by bats. Acoustic data will allow species identification, although Townsend's big-eared bats emit faint calls and may not be recorded.

A detailed knowledge of species composition and activity at a fixed point provides a necessary understanding of use of that particular habitat feature or resource. However, this cannot be extrapolated to the landscape level. Further, the sites selected for sampling are those known or suspected of having attractant qualities. Therefore, bat presence should be concentrated at those sites. Because of sampling restrictions, little is known about how bats disperse and use the landscape away from these specialized

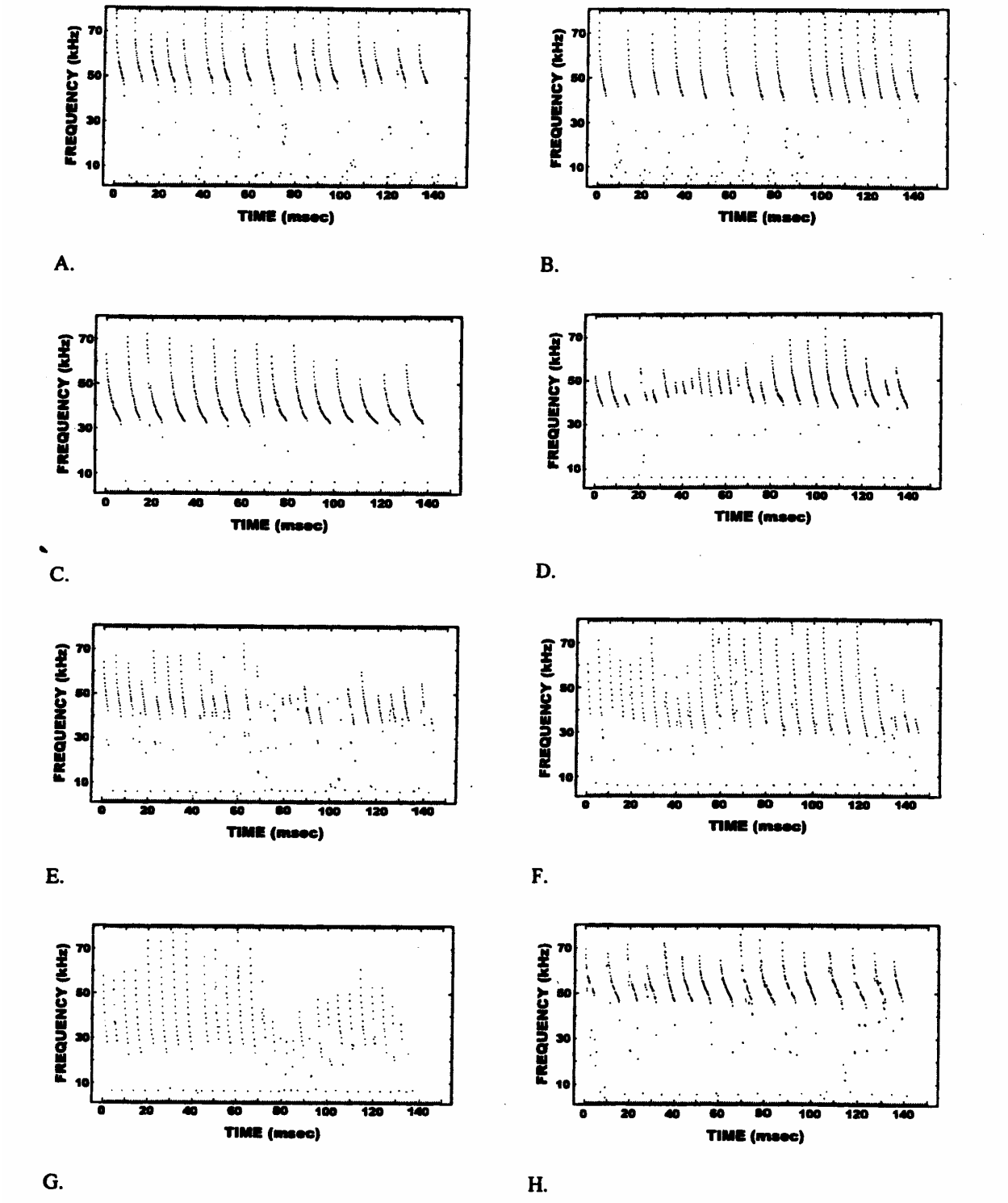
habitat features. Mobile acoustic sampling, similar to radio-telemetry in this context, can be used to examine landscape level bat use.

Routes should be selected carefully. Any road with night traffic can be dangerous and should be avoided. For mobile surveys, it is imperative that the time, mileage and GPS coordinate be taken at the beginning and end of each transect. The standard protocol for conducting a mobile survey includes driving between five and ten mph. The area ahead, to the side, and behind the vehicle should be scanned continuously while driving. When a bat is encountered, stop the vehicle immediately and actively monitor the surroundings for one minute. Mileage and/or a GPS fix should be taken. If no further vocalizations are detected, continue driving. If more bat activity is detected, continue monitoring for five minutes, and then proceed with driving. Visual techniques (e.g., spotlight) should be incorporated to assist in verifying species identity. Visual verification should be noted for specific files and that information incorporated into the text header. A single recording would indicate a commuting bat. More prolonged activity may indicate a foraging site or other habitat feature resulting in concentrated use. Each location resulting in a vehicle stop should be examined during the day and characterized by habitat and any features that might provide insight into bat use. A specific transect should stay within a specific habitat type. Multiple transects can be conducted in a single night. Although large areas of habitat can be examined, recognize that away from water or other attractant features, there may be relatively little bat use. For example, surveys through broad desert valleys without development may not yield a single encounter. However, with sufficient effort, it should be possible to locate movement corridors and localized feeding areas. These sites may be constant or they may change through time. Such knowledge is critical to the understanding and subsequent management of bats and is unattainable through most other field survey methods.

The form data sheet for acoustic sampling provides the minimum data that should be collected when conducting either fixed-point or mobile monitoring. If passive and active sampling is conducted simultaneously, multiple computers will be used. Number each computer and associated detector and ZCAIM so that all the equipment in a given setup remains constant. Also record which computers were assigned to the active and passive positions (e.g., STATIONARY LINE: Active #2, Passive #1 and #3 etc). If each is sampling different habitats, that information would be provided in the next two lines, separated by semicolons, respectively. If they are at widely divergent locations, UTM or Lat/Lon coordinates need to be provided for each (that information is always incorporated in the default text header in Anabat6).

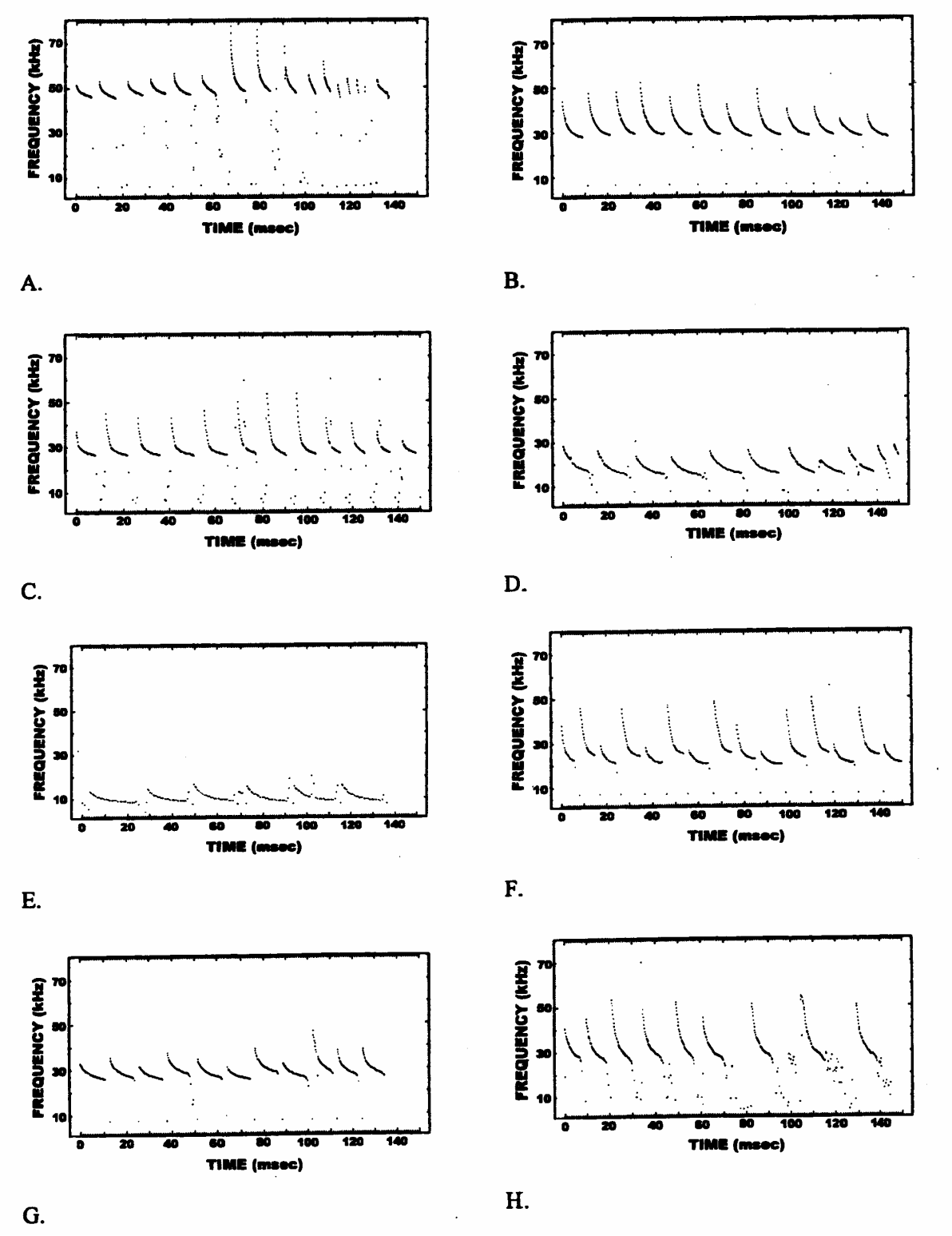
As soon after collecting the data as possible, recorded files should be examined and species identity assigned (species codes entered for the species field in the text header). A representative file name (indicating a time date stamp as assigned by Anabat6) for each species encountered must be entered on the form. These files should be selected as the best representation of that species providing the basis for identification.

Any report of the results of capture or acoustic surveys should include copies of the completed data sheets in an appendix. Agency reports (e.g., annual report to NDOW for Scientific Collection Permit) should also include copies of acoustic voucher files. At least one would be required per species. However, if available, at least ten of the best quality files should be included for each species identified from each locality surveyed.



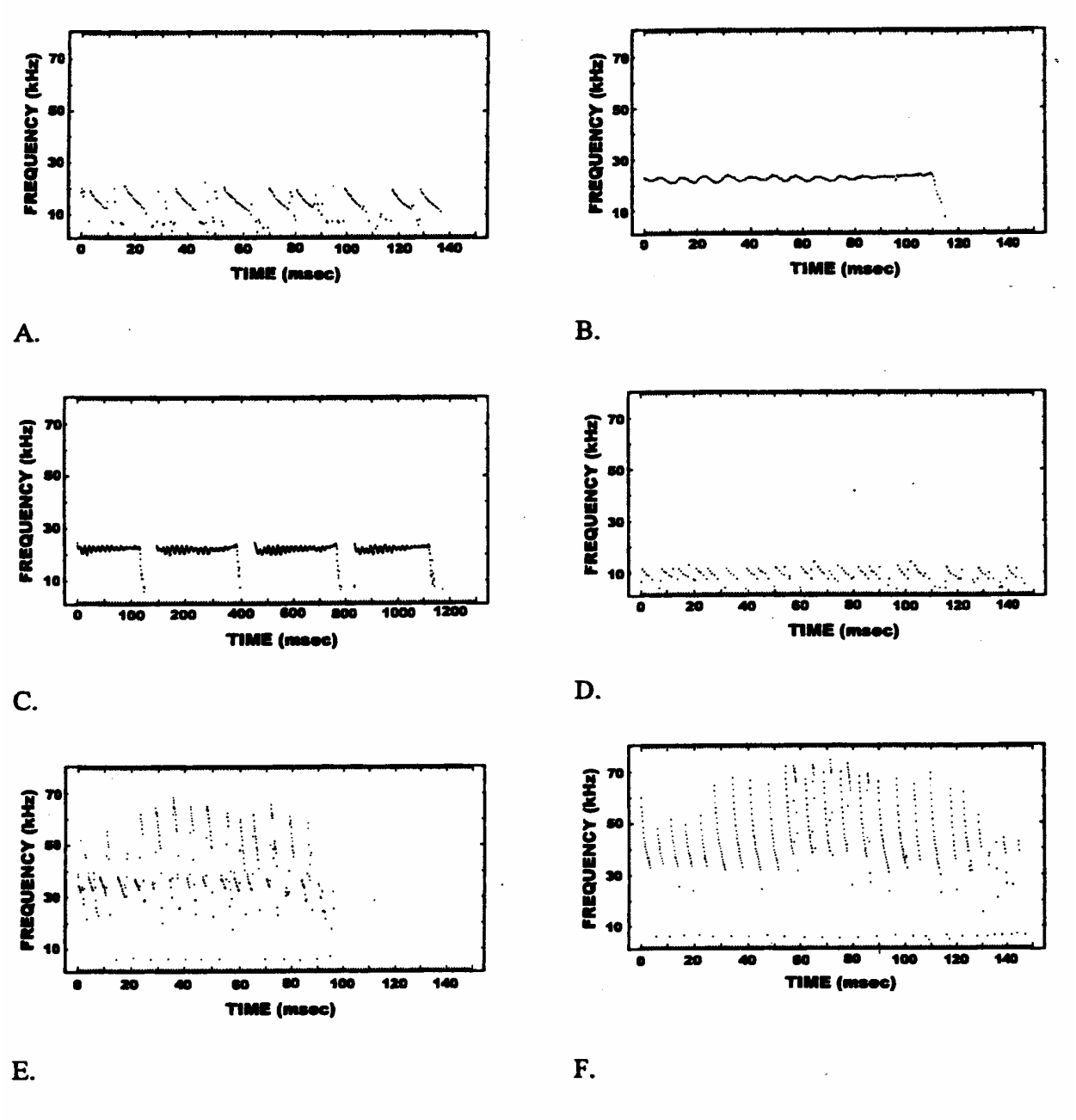
Select Anabat echolocation calls: (O'Farrell, 1997)

A) Myotis californicus, B) M. ciliolabrum, C) M. occultus, D) M. volans, E) A. auriculus, F) M. evotis, G) M. thysanodes, H) M. yumanensis.



Select Anabat echolocation calls: (O'Farrell, 1997)

A) Pipistrellus hesperus, B) Eptesicus fuscus, C) Lasionycteris noctivagans, D) Nyctinomops macrotis, E) Eumops perotis, F) Lasiurus cinereus, G & H) Tadarida brasiliensis.



Select Anabat echolocation calls: (O'Farrell, 1997) ***A, B & C) Idionycteris phyllotis, D) Euderma maculatum, E) Corynorhinus townsendii, F) Antrozous pallidus.***

Western Bat Working Group

RECOMMENDED SURVEY METHODS MATRIX

BAT GROUPS		TYPE OF SURVEY				NOTES
		NETTING	ROOST	ACOUSTIC (passive)	ACOUSTIC + VISUAL (active)	
Eptesicus fuscus	Big brown bat	1	3	3	1	**Netting- Capture: Readily captured in mist nets, but problematic in open areas, especially where water is abundant. ID: Morphologically distinct. Roost- Location: Easy to locate man-made roosts; difficult in most natural roosts (e.g., trees and rock crevices). Natural roosts dominate throughout much of range. Night roost surveys often effective. ID: Colonies often conspicuous, species easy to ID. Passive Acoustic- Detection: Easy. ID: subset of sequences diagnostic acoustic overlap with Lasionycteris and Tadarida. Active Acoustic- Visually distinctive in flight.**
Myotis californicus	California myotis	1	4	3	1	**Netting- Capture: Readily captured in mist nets. ID: Morphologically similar to M. ciliolabrum. Can be distinguished from M. ciliolabrum by combination of capture and recording of hand-release echolocation call. Roost- Location: Can be found in man-made roosts, but generally non-colonial and crevice-roosting; most roosts not man-made and difficult to find. Sometimes found in night roosts. ID: Requires handling for positive identification. Passive Acoustic- Detection: Easy. ID: Difficult to distinguish from Myotis yumanensis (50K Myotis). Active Acoustic: Flight behavior distinguishes it from M. yumanensis in most settings.**

Myotis evotis	Long-eared myotis	1	3	2	2	**Netting- Capture: Readily captured in mist nets at both aquatic and terrestrial sites. ID: Morphologically distinct except in areas of overlap with M. auriculus, M. keenii, or M. septentrionalis. Also similarity to M. thysanodes in some regions. Roost- Location: Can be detected in man-made roosts, but often cryptic; difficult in most natural roosts (e.g., trees and rock crevices). Natural roosts dominate. Sometimes in night roosts, particularly mines and bridges, although extent to which these features are used varies regionally. ID: Small colonies. Generally crevice roosting. Often requires handling for positive identification. Passive Acoustic- Detection: Intermediate intensity calls. ID: Subset of sequences diagnostic except in area of geographic overlap with M. auriculus, M. septentrionalis or possibly M. keenii. Also possible confusion under some habitat conditions with 40 kHz Myotis. Active Acoustic - May be helpful in distinguishing it from short-eared Myotis.**
Myotis keenii	Keen's myotis	4	5	U	U	**Netting- Capture: Difficult to find. Most netting records from known cave roosts. ID: Issues currently unresolved, but probably difficult to distinguish from M. evotis. Due to uncertainties regarding ID, morphometric data, hand-release calls, and wing-biopsy should be collected from all individuals. Roost- Location: Can be detected in caves and buildings, but difficult in tree roosts. Tree roosts probably dominate. ID: Small colonies and difficult to distinguish from M. evotis. Often requires handling for positive identification. Passive Acoustic- Detection: Presumably has intensity similar to M. evotis. ID: Issues currently unresolved, but likely difficult to distinguish from M. evotis Active Acoustic- Unknown**
Myotis septentrionalis	Northern myotis	3	3	2	2	**Netting- Capture: More successful in interior forest than over water in eastern deciduous forest; harp traps set in gaps between trees effective in SD and WY. Occasionally captured over water. ID: Easy except where range overlaps with M. evotis. Roost- Location: Surveys for night roosts and hibernacula can be effective; day roosts under bark. ID: Very cryptic in day roosts. Requires handling for positive identification. Passive Acoustic- Detection: Intermediate intensity calls ID: Many sequences diagnostic, but overlap with other 40 K Myotis, particularly M. lucifugus. Also potential for confusion with M. evotis. Active Acoustic- May be helpful in distinguishing it from small -eared Myotis. Often flies in cluttered settings where ID can be difficult.**

Myotis thysanodes	Fringed myotis	1	3	2	2	**Netting- Capture: Readily captured in mist nets (often on secondary streams in northwestern portion of range). ID: Generally easy, but morphologically similar to M. evotis in some regions. Roosts- Location: Can be detected in man-made roosts, but difficult in most natural roosts (e.g., trees and rock crevices). Natural roosts dominate. Sometimes found in night roosts. ID: Small colonies and often in crevices. Requires handling for positive identification. Passive Acoustic- Detection: Intermediate intensity calls. ID: Many sequences/calls diagnostic. Possible confusion with A. pallidus. Active Acoustic- Flight behavior, in combination with call morphology, sometimes helpful.**
Myotis yumanensis	Yuma myotis	1	2	3	1	**Netting- Capture: Water-skimming foraging style makes this species highly vulnerable to capture in mist-nets set over still water. ID: Morphologically similar to M. lucifugus and M. occultus. Can be distinguished from M. lucifugus and M. occultus by combination of capture and recording of hand-release echolocation call. Roost- Location: Commonly in man-made roosts. Form large aggregations in night roosts (particularly bridges). Difficult to locate most natural roosts. ID: Highly colonial and easy to detect in man-made roosts. Requires handling for positive identification. Passive Acoustic- Detection: Easy to detect acoustically. ID: Difficult to distinguish from M. californicus, though some calls diagnostic (50K Myotis). Active acoustic- Flight behavior, particularly water skimming, distinctive.**
Antrozous pallidus	Pallid bat	1	3	2	1	**Netting- Capture: Fly low to ground and readily captured in nets (often in upland habitats). ID: Morphologically distinct. Roost- Location: Easy to detect colonies in man-made roosts; difficult in most natural roosts (e.g., trees and rock crevices). Frequently uses man-made roosts (mines, bridges, buildings) in parts of its range. Often found in night roosts, especially mines and bridges. ID: Roost conspicuously, easy to ID. Guano with characteristic culled insect parts (particularly Jerusalem crickets and scorpions) often distinctive. Passive Acoustic- Detection: Easy to detect acoustically. ID: Subset of calls diagnostic, particularly if it gives a "directive" call. Active acoustic- Visually distinctive.**

Idionycteris phyllotis	Allen's big-eared bat	3	3	2	2	**Netting- Capture: Captured infrequently in mist nets; show loyalty to particular water sources, but may be difficult to locate in initial surveys. ID: Morphologically similar to C. townsendii. Roost- Location: Easy to detect in man-made roosts (e.g., mines); difficult in natural roosts (e.g., trees, rock crevices). ID: Easy: roost in clusters on open surface (e.g., domes of mines). May be confused with C. townsendii. Passive Acoustic- Detection: Easy to detect acoustically (with low frequency microphone). ID: Most sequences diagnostic, except can be difficult to distinguish from E. maculatum. Geographic overlap with E. maculatum throughout much of its range. Highly distinctive social call. Active Acoustic- Can be difficult to distinguish from E. maculatum.**
Myotis auriculus	Southwestern myotis	1	5	U	U	**Netting- Capture: Readily captured in mist nets. ID: Morphologically distinct except where range overlaps with M. evotis. Roost- Location: Easy to detect in man-made roosts; difficult in most natural roosts. Likely that natural roosts dominate. ID: Roost in small groups. Requires handling for positive identification. Passive Acoustic- Detection: Easy to detect acoustically. ID: Probably many sequences diagnostic except in area of geographic overlap with Myotis evotis. Active Acoustic- Visual cues will not help distinguish from M. evotis.**
Myotis ciliolabrum	Small-footed myotis	2	3	4	4	**Netting- Capture: Readily captured in nets in some portions of its range; but vulnerability to netting may vary regionally. ID: Morphologically similar to M. californicus. Can be reliably identified using combination of morphological and acoustic data. Roost- Location: Predominantly non-colonial. Frequently in mines, but natural roosts likely dominate, and difficult to find. Sometimes found in night roosts. ID: Roost in small groups. Requires handling for positive identification. Passive acoustic- Detection: Easy to detect acoustically. ID: Not currently distinguishable from other 40K Myotis. Active acoustic- Can sometimes be distinguished when observed in flight, but requires experience.**

Myotis lucifugus	Little brown bat	2	3	4	3	**Netting- Capture: Readily netted in some areas; net-avoidant in others. ID: Morphologically similar to M. yumanensis and M. occultus. Can be reliably identified using combination of morphological and acoustic data. Roost- Location: Frequently in man-made roosts (mines, bridges, buildings) in parts of its range. Difficult to find in most natural roosts (e.g., trees and rock crevices). Sometimes found in night roosts. ID: Highly colonial and easy to detect in man-made roosts. Often requires handling for positive identification. Passive Acoustic- Detection: Easy to detect acoustically. ID: Some calls/sequences diagnostic, though probably not distinguishable from M. occultus in areas of geographic overlap. Difficult to distinguish from other 40K Myotis. Active Acoustic- Flight behavior sometimes distinctive, particularly over water.**
Myotis occultus	Arizona myotis	2	3	4	4	**Netting- Capture: Fairly easy to capture in nets. ID: May be difficult to distinguish from M. lucifugus in areas of overlap. Roost- Location: Roost in man-made roosts, but natural roosts dominate. Can often be found in night roosts. ID: Easy to detect in man-made roosts; difficult in most natural roosts. Often requires handling for positive identification. Passive acoustic- Detection: Easy to detect acoustically. ID: Issues currently unresolved but probably difficult to distinguish acoustically from other 40K Myotis. Active Acoustic- Difficult to distinguish visually.**
Myotis volans	Long-legged myotis	2	2	4	3	**Netting- Capture: Effectiveness of netting varies regionally, and setting makes a difference. ID: Morphologically distinct. Roost- Location: Can be found in man-made roosts; difficult in most natural roosts. Natural roosts dominate. Often found in night roosts. ID: Requires handling for positive identification. Passive Acoustic- Detection: Easy to detect acoustically. ID: Issues currently unresolved with other 40K Myotis. Active Acoustic- Flight behavior can be distinctive (long tail membrane).**

Tadarida brasiliensis	Brazilian free-tailed bat	2	1	1	1	**Netting- Capture: While sometimes captured in mist nets, this species flies high and is generally more abundant than net captures would suggest. ID: Generally distinctive, but potentially confused with N. femorosaccus. Roost- Location: Highly colonial and easy to detect in man-made roosts; difficult in most natural roosts. Natural roosts (e.g., cliff roosts) dominate in large portion of range. Commonly in man-made roosts in portion of its range. ID: Easy to locate and ID in most roosts. Guano and odor distinctive. Passive acoustic- Detection: Easy to detect acoustically. ID: Some calls overlap with other species (Lasionysteris, Eptesicus, L. cinereus, N. femorosaccus), but fair proportion are diagnostic. In most settings this would be the easiest way to detect the species. Active Acoustic- Visually distinctive except where overlaps with N. femorosaccus.**
Lasionycteris noctivagans	Silver haired bat	1	5	4	2	**Netting- Capture: Vulnerability to net capture varies with habitat, but generally quite susceptible to capture. Captured over water sources (large and small). ID: Morphologically distinct. Roost- Location: Very difficult to locate in natural roosts (e.g. trees and snags). ID: Unlikely to locate via roost search but, can be distinguished visually in flight upon exit. Passive Acoustic- Detection: Easy to detect acoustically. ID: Some calls distinctive, but overlap with Tadarida and Eptesicus. In areas without Tadarida, many sequences are diagnostic. Active Acoustic- With experience can be distinguished visually in flight.**
Lasiurus blossevillii	western red bat	3	5	2	1	**Netting- Capture: Sometimes captured in mist nets, but foraging areas often not suitable for netting (e.g., over large water sources). ID: Morphologically distinct except where overlaps with L. borealis. Roost- Location: Non-colonial. Very difficult to locate tree roosts. ID: Difficult to locate bats in foliage, easy to ID except where overlaps with L. borealis. Passive acoustic- Detection: Easy to detect acoustically. ID: Most sequences diagnostic in areas without L. borealis. In areas with L. borealis, extensive acoustic overlap, but probably distinguishable statistically. Some acoustic overlap with P. hesperus. Active Acoustic- Distinctive in flight except in areas with L. borealis.**

Lasiurus borealis	Eastern red bat	2	5	2	1	**Netting- Capture: Readily captured over water and in side channels in eastern U.S. ID: Morphologically distinct except where overlaps with L. blossevillii. Roost- Location: Difficult to locate tree roosts. ID: Difficult to locate bats in foliage, easy to ID except where overlaps with L. blossevillii. Passive Acoustic- Detection: Easy to detect acoustically. ID: Most sequences diagnostic in areas without L. blossevillii. In areas with L. blossevillii, extensive overlap but probably distinguishable statistically. Active Acoustic- Distinctive in flight except in areas with L. blossevilli.**
Lasiurus cinereus	Hoary bat	3	5	2	1	**Netting- Capture: Fly high; often under-represented in net captures. Often foraging in areas that cannot be feasibly netted. ID: Morphologically distinct. Roost- Location: Non-colonial. Very difficult to locate tree roosts. ID: Difficult to locate bats in foliage but easy to distinguish from other species. Passive Acoustic- Detection: Easy to detect acoustically. ID: Many calls diagnostic throughout much of its range; subset of calls overlap with Tadarida and N. femorosacccus. Active Acoustic- Distinctive in flight.**
Lasiurus xanthinus	Southern yellow bat	3	3	2	1	**Netting- Capture: Readily captured in some habitats; apparently difficult in others. Not enough known about appropriate habitats. ID: Morphologically distinct. Roost- Location: Difficult to locate tree roosts. Can sometimes be located by monitoring palm trees at emergence time. ID: Difficult to observe in roost, but easy to ID during emergence from roost. Passive acoustic- Detection: Easy to detect acoustically. ID: Most sequences diagnostic, but some acoustic overlap with L. borealis and E. fuscus. Active acoustic- Reasonably distinctive in flight.**

Euderma maculatum	Spotted bat	3	5	2	1	**Netting- Capture: Can be effective where water is a limiting factor in xeric conditions, although netting is not effective in many portions of range. ID: Morphologically distinct. Roost- Location: Non-colonial, cliff-roosting; very difficult to locate and generally inaccessible. ID: Unknown; no roosts have been visually inspected; only locations have been from a distance using radio-telemetry. Passive acoustic- Detection: Easy to detect acoustically (with microphones sensitive to audible frequencies). Calls are audible to many people ID: Most sequences diagnostic, except in areas of geographic overlap with I. phyllotis. Active acoustic- Difficult to distinguish from I. phyllotis; otherwise distinctive in flight.**
Pipistrellus hesperus	western pipistrelle	2	5	1	1	**Netting- Capture: Captured in nets fairly readily, although often fly high. ID: Morphologically distinct. Roost- Location: Predominantly cliff-roosting. Some roosting in man-made structures, particularly mines. ID: Usually non-colonial or small colonies. Can be identified visually at very close range. Passive acoustic- Detection: Easy to detect acoustically. ID: Most calls diagnostic, although some overlap with L. blossevillii. Active Acoustic- Visually distinctive.**
Eumops perotis	western mastiff bat	3	3	1	1	**Netting- Capture: Effectiveness of netting varies regionally. Have been netted where open flight paths are evident, or water is limiting. Forage at considerable heights; captured at drinking sites. ID: Morphologically distinct. Roost- Location: Most roost in cliffs and are highly inaccessible; quite frequently in building roost. Can sometimes be found by surveying for guano and listening for loud chatter along base of cliffs. ID: Generally requires monitoring at emergence. Passive Acoustic- Detection: Easy to detect acoustically (better with low frequency microphone). Calls in the audible range for many people. ID: Calls diagnostic. Active Acoustic- Distinctive except in areas of overlap with E. underwoodi.**

Eumops underwoodi	Underwood's mastiff bat	3	U	1	1	**Netting- Capture: Logistically difficult, requiring net sets over large bodies of water. ID: Morphologically distinct. Roost- Poorly known; one study radiotracked to saguaro cactus. Passive Acoustic- Detection: Easy to detect acoustically (better with low frequency microphone). Calls in the audible range for many people. ID: Calls diagnostic except where range overlaps with N. macrotis. Active Acoustic- Distinctive except in areas of overlap with E. perotis and N. macrotis.**
Nyctinomops femorosaccus	Pocketed free-tailed bat	3	3	2	1	**Netting- Capture: Effective in low-elevation canyon sites, and near known roosts. ID: Morphologically distinct, but potentially confused with T. brasiliensis. Roost- Location: Roosts often inaccessible. Roosts primarily in cliffs. Sometimes possible to find roosts by surveying for guano and listening for chatter at base of cliffs. ID: Generally requires monitoring at emergence. Passive Acoustic- Detection: Easy to detect acoustically; calls in the audible range for some people. ID: Subset of calls/sequences diagnostic, some overlap with both Tadarida and L. cinereus. Active Acoustic- Useful for distinguishing from L. cinereus.**
Nyctinomops macrotis	Big free-tailed bat	3	5	1	1	**Netting- Capture: Records extremely limited suggesting serious challenges. ID: Morphologically distinct. Roost- Location: Generally cliffs and rock crevices; often inaccessible. Also known to use building and tree roosts. Guano deposits and chatter can potentially be used to locate roosts, but generally not effective. ID: Generally requires monitoring at emergence. Passive Acoustic- Detection: Easy to detect acoustically (best with low frequency microphone); calls in audible range for some people. ID: Most calls diagnostic, but overlap with E. underwoodi and possibly E. perotis. Species poorly known. Active Acoustic- Indistinguishable from Eumops in flight.**

Choeronycteris mexicana	Mexican long-tongued bat	3	3	U	4	**Netting- Capture: Effectiveness of netting depends on habitat type. ID: Morphologically distinct. Roosts- Location: Difficult to find. ID: Easy to detect in roost. Passive Acoustic- Detection: Difficult to detect acoustically. ID: Issues currently unresolved. Active Acoustic- Indistinguishable from Leptonycteris species, except at very close range (e.g. hummingbird feeders).**
Leptonycteris curasoae	Lesser long-nosed bat	3	1	U	4	**Netting- Capture: Effectiveness of netting depends on habitat type .ID: Morphologically distinct. Roost- Location: Roosts in mines and caves; highly colonial. ID: Easy to detect and ID in roost except in areas of overlap with L. nivalis. Passive acoustic- Detection: Difficult to detect acoustically. ID: Issues currently unresolved. Active acoustic- Indistinguishable in flight from L. nivalis and Choeronycteris, except possibly at very close range (e.g. hummingbird feeders).**
Leptonycteris nivalis	Big long-nosed bat	3	1	U	4	**Netting- Capture: Effectiveness of netting depends on habitat type. ID: Morphologically distinct. Roost- Location: Roosts in mines and caves; colonial. ID: Easy to locate and ID, except in areas of overlap with L. curasoae. Passive Acoustic- Detection: Unknown, but presumably difficult to detect acoustically. ID: Issues currently unresolved. Active Acoustic- Indistinguishable in flight from L. curasoae and Choeronycteris, except possibly at very close range (e.g. hummingbird feeders).**

Macrotus californicus	California leaf-nosed bat	4	1	4	4	**Netting- Capture: Avoids mist nets. ID: Morphologically distinct. Roost- Location: Most effectively found by searching for colonial roosts, primarily in mines and caves. ID: Easy to locate and ID in roost. Passive Acoustic- Detection: Difficult to detect acoustically. ID: Subset of calls diagnostic. Active Acoustic- Can ID visually at close range.**
Mormoops megalophylla	Ghost-faced bat	2	2	1	1	**Netting- Capture: Readily captured in nets, but very delicate and often die. Suggest using harp traps. ID: Morphologically distinct. Roost- Location: Roosts in caves ID: Presumably easy to locate and ID when present. Passive Acoustic- Detection: Easy to detect acoustically. ID: Calls highly diagnostic. Active Acoustic- So distinctive acoustically that visual observation does not contribute to ID.**
Corynorhinus townsendii	Townsend's big-eared bat	3	2	4	4	**Netting- Capture: Effective at avoiding mist-nets. ID: Morphologically similar to I. phyllotis. Roost- Location: Most effectively found by searching for colonial roosts, in mines and caves. Roosts in buildings in coastal portion of range. Some portions of range, particularly Canada and some desert areas, roosts very difficult to locate. ID: Easy to locate and ID in roost. Passive Acoustic- Detection: Difficult to detect acoustically, low intensity calls ("whispering bat"). ID: Calls, when detected, are diagnostic. Active Acoustic- Visually distinctive in most settings.**

	Myotis velifer	Cave myotis	2	1	3	3	**Netting- Capture: Limited usefulness in some habitats. ID: Morphologically distinct, but potentially confused with M. occultus or M. lucifugus. Roost- Location: Primarily in caves and rock crevices, but occasionally in buildings. ID: Roost colonially; can be confused with other colonially roosting Myotis and E. fuscus. Passive Acoustic- Detection: Easy to detect acoustically. ID: Overlap with other 40K Myotis. Acoustic ID best in areas without other 40 kHz Myotis. Active Acoustic- Visually similar to other 40 kHz Myotis.**
	KEY							
1	**Preferred or highly effective**							
2	**Effective in most habitats**							
3	**Effective in some habitats**							
4	**Presents serious challenges**							
5	**Generally not effective**							
U	**Unknown**							








APPENDIX B

Attorney General's Opinion

OPINION NO. 94-08 LIABILITY; MINING; MINERALS, DEPT. OF; COUNTIES; B.L.M.; RECREATIONAL LAND USE; LANDS, PUBLIC: Fencing dangerous abandoned mine sites by the Division of Minerals or the counties, in the manner prescribed by regulation and with the permission of the landowner, is protected activity under relevant immunity statutes and Nevada's recreational use statutes.

Carson City, April 21, 1994

Mr. Russell A. Fields, Administrator, Division of Minerals, 400 W. King Street, Suite 106, Carson City, Nevada 89710

Dear Mr. Fields:

In response to the legislative direction to the Division of Minerals to create and administer a program for the abatement of dangerous conditions existing at abandoned mine sites in Nevada, you have requested an opinion from this office concerning the existence of civil liability with respect to the proposed program of fencing dangerous mine sites.

QUESTION

Does fencing abandoned mine sites in the manner prescribed by regulation satisfy the state's statutory requirements as found in NRS 455.010, *et seq.*, and NRS 513.073, *et seq.*, thus providing to the state, county or other responsible parties civil immunity from suit pursuant to NRS 41.510 and NRS 41.0331 from anyone injured at that location subsequent to fencing?

ANALYSIS

In 1989, this office issued a letter opinion in response to two questions from your department. Both questions concerned the existence of civil liability with respect to dangerous mine shafts. (Letter Opinion, October 24, 1989, authored by Brian Chally, Senior Deputy Attorney General.)

The 1989 opinion concluded, under Question One, that the owner or possessor of a mine shaft is at no time relieved of the duty to fence under NRS 455.010; however, NRS 41.510 does provide immunity from civil liability under certain conditions. NRS 41.510 provides immunity to a land owner against any person injured while involved in recreational activities on his land, except where the land owner has acted willfully or maliciously, or where the land owner has allowed access to his land in exchange for consideration.

The second question, answered in 1989, was whether a property owner could be held civilly liable when a person destroys or circumvents fencing and then is injured by falling into a shaft. The opinion concluded that immunity provided by NRS 41.510 should apply "since an effort to destroy the fence to explore the shaft or even for the sole diversion of the destruction [of the fence] involved would fit within the definition of recreation." Ultimately, the opinion concluded that immunity from civil liability is available to the land owner even when a person destroys the fencing around the shaft and then is injured.

The opinion did not address your concern for potential civil liability to the state, county or other responsible parties who are not landowners but who fence dangerous abandoned mine sites in cooperation with the legislative mandate. In 1987, the legislature gave the Division of Minerals a mandate to create and administer a program for the identification of dangerous conditions existing at abandoned mine sites, and a duty to identify and rank them pursuant to the degree of danger. NRS 513.094. Furthermore the statute requires the Commission on Mineral Resources to establish by regulation, standards allowing you to rank dangerous conditions and standards for use in abatement of those dangerous conditions. Once a year the Division is required to inform each board of county commissioners of dangerous conditions found in their counties. The counties may then apply to the Division for monies to abate the dangerous conditions identified. NRS 513.108. This program is directed at those mine lands which are abandoned and for which there is no responsible party or current owner or operator.

The word "abatement" must be defined in order to give scope and definition to the legislative mandate. *State v. Webster*, 102 Nev. 450, 453, 726 P.2d 831 (1986) (The meaning of certain words in a statute may be determined after examination of the context in which they are used and by considering the spirit of the law, *citing Welfare Division v. Washoe County Welfare Dep't.*, 88 Nev. 635, 637-38, 503 P.2d 457 (1972)). The word "abatement" as defined in Black's Law Dictionary (6th ed. 1990) means "a reduction, a decrease, or a diminution." As applied to the Division's program, there is a distinction between diminishing or reducing dangerous conditions at an abandoned mine site and completely eliminating the dangerous condition. Fencing a dangerous condition does not eliminate it completely. Only by backfilling a dangerous condition can hazards to humans and animals be completely eliminated. The statutory mandate includes the development of standards for abating dangers which will exclude humans and animals. The legislature chose the word "abatement"; therefore, I believe the mandate is to diminish and/or reduce dangerous conditions at abandoned mine sites using methods or combinations of methods that effectively exclude persons and animals. *Dumaine v. State*, 103 Nev. 121, 125, 734 P.2d 1230 (1987) (words will be given ordinary meaning if possible); *State v. State of Nevada Employees Association, Inc.*, 102 Nev. 287, 289, 720 P.2d 697 (1986) (words which have definite and plain meaning retain that meaning unless clearly not intended). The plain meaning of the statutory mandate to abate dangerous conditions does not prescribe backfilling or any other specific method; therefore, fencing is within the contemplation of the legislature when it enacted NRS 513.094(2) and (4).

[18]
2. The administrator shall, within the limits of the money provided by this fee, establish a program to discover dangerous conditions that result from mining practices which took place at a mine that is no longer operating, identify if feasible the owner or other person responsible for the condition, and rank the conditions found in descending order of danger. He shall annually during the month of January, or more often if the danger discovered warrants, inform each board of county commissioners concerning the dangerous conditions found in the respective counties, including their degree of danger relative to one another and to such conditions found in the state as a whole. He shall further work to educate the public to recognize and avoid those hazards resulting from mining practices which took place at a mine that is no longer operating.
. . . .
4. The commission shall provide by regulation:
(a) Standards for determining which conditions created by the abandonment of a former mine or its associated works constitute a danger to persons or animals and for determining the relative degree of danger. A condition whose existence violates a federal or state statute or regulation intended to protect public health or safety is a danger by virtue of that violation.
(b) Standards for abating the kinds of dangers usually found, including but not limited to standards for excluding persons and animals from dangerous open excavations.

The issue of liability with regard to the program of fencing dangerous conditions at mine sites has been the subject of several discussions and meetings among interested parties and participants in the abandoned mine lands program. A review of the applicable statutes in Nevada follows. Briefly, in 1866, the Nevada Legislature enacted the statute requiring any person who sank a shaft or excavation to cause to be erected a good and substantial fence or other safeguard and keep the same in good repair around mine works or shafts, sufficient to guard securely against danger to persons and animals. NRS 455.010.[19] (*See infra* for analysis of liability under NRS 455.010.) In 1963, the legislature added to chapter 41, a statute designed to limit a land owner's liability which is referred to as the state's "recreational use" statute. NRS 41.510.[20] NRS 41.510 provides that an owner, lessee, or occupant of premises owes no duty to keep the premises safe for entry or use by anyone using his land in a recreational capacity. The land owner is under no duty to give a warning of any hazardous condition, activity, or use of any structure on the premises to persons entering for recreational purposes. The only exception which removes the statutory shield is willful or malicious failure to guard or warn against a dangerous condition, use, structure or activity or where the land owner grants entry to his land in exchange for consideration. Finally, the legislature in 1989, added NRS 41.0331 which makes a person or any political subdivision of the state immune from civil liability for damages as a result of any act by him or it in constructing or causing to be constructed, pursuant to standards prescribed by the commission on mineral resources, a fence or other safeguard around an excavation.[21] Against this background of statutory

[19] Any person or persons, company or corporation, who shall dig, sink or excavate, or cause the same to be done, or being the owner or owners, or in the possession under any lease or contract, of any shaft, excavation or hole, whether used for mining or otherwise, or whether dug, sunk or excavated for the purpose of mining, to obtain water, or for any other purpose, within this state, shall, during the time they may be employed in digging, sinking or excavating, or after they may have ceased work upon or abandoned the same, erect, or cause to be erected, good and substantial fences or other safeguards, and keep the same in good repair, around such works or shafts, sufficient to guard securely against danger to persons and animals from falling into such shafts or excavations.

[20] 1. Except as otherwise provided in subsection 3, an owner, lessee or occupant of premises owes no duty to keep the premises safe for entry or use by others for crossing over to public land, hunting, fishing, trapping, camping, hiking, sightseeing, hang gliding, para-gliding or for any other recreational purposes, or to give warning of any hazardous condition, activity or use of any structure on the premises to persons entering for those purposes.
2. Except as otherwise provided in subsection 3, if an owner, lessee or occupant of premises gives permission to another to cross over to public land, hunt, fish, trap, camp, hike, sightsee, hang glide, para-glide or participate in other recreational activities, upon his premises:
(a) He does not thereby extend any assurance that the premises are safe for that purpose, constitute the person to whom permission is granted an invitee to whom a duty of care is owed, or assume responsibility for or incur liability for any injury to person or property caused by any act of persons to whom the permission is granted.
(b) That person does not thereby acquired any property rights in or rights of easement to the premises.
3. This section does not:
(a) Limit the liability which would otherwise exist for:
(1) Willful or malicious failure to guard, or to warn against, a dangerous condition, use, structure or activity.
(2) Injury suffered in any case where permission to cross over to public land, hunt, fish, trap, camp, hike, sightsee, hang glide, paraglide or participate in other recreation activities, was granted for a consideration other than the consideration, if any, paid to the landowner by the state or any subdivision thereof. For the purposes of this subparagraph, the price paid for a game tag sold pursuant to NRS 502.145 by an owner, lessee or manager of the premises shall not be deemed consideration given for permission to hunt on the premises.
(3) Injury caused by acts of persons to whom permission to cross over to public land, hunt, fish, trap, camp, hike, sightsee, hang glide, para-glide or participate in other recreational activities was granted, to other persons as to whom the person granting permission, or the owner, lessee or occupant of the premises, owed a duty to keep the premises safe or to warn of danger.
(b) Create a duty of care or ground of liability for injury to person or property.

[21] A person, the State of Nevada, any political subdivision of the state, any agency of the state or any agency of its political subdivisions is immune from civil liability for damages sustained as a result of any act or omission by him or it in constructing, or causing to be constructed, pursuant to standards prescribed by the commission on mineral resources, a fence or other safeguard around an excavation, shaft, hole or other dangerous condition at an abandoned mine for which the person, state, political subdivision or agency is not otherwise responsible.

immunity and statutory limitations in protecting the public and animals from injury as a result of dangerous conditions at abandoned mine lands, you must still consider whether the state or other responsible parties who fence dangerous conditions at abandoned mine sites may rely on the protections found in the immunity statutes.

Recently, the Nevada Supreme Court has construed NRS 455.010, a statute which requires the owner or possessor of a "shaft, excavation or hole" to erect a "fence or other safeguard" to protect people and animals from falling in. *Ross v. Carson Construction*, 106 Nev. 885, 803 P.2d 657 (1990). This was a construction site case, where the plaintiff drove into a temporary excavation and was injured. The court unequivocally held that NRS 455.010 imposes an absolute duty to safeguard open excavations regardless of permanency. 106 Nev. at 889. In reviewing prior case law in Nevada, the court found NRS 455.010 applied to property owners whether on private ground or public ground. 106 Nev. at 888, *see Orr Ditch & Water Co. v. Justice Court*, 64 Nev. 138, 144-45, 128 P.2d 558, 561-62 (1947) (primary intent of statute was the prevention of injuries suffered from falling into unprotected mine shafts).

The *Ross* court cited an early Nevada case which suggests that this absolute duty to safeguard open excavations only runs to those who dug the shaft or thereafter abandoned it. *Ross*, 106 Nev. at 887, *citing Dixon v. Simpson*, 74 Nev. 358, 362, 332 P.2d 656 (1958). In *Dixon*, the court specifically considered whether the landowner and the subcontractor were responsible for injuries to a pedestrian who fell into an open excavation at a construction site. After applying NRS 455.010 to the facts, the court determined that the duty to guard against hazardous conditions applied only to those who dug the excavation and retained control over it; therefore, only the owner was liable since the subcontractor had relinquished control over the excavation prior to plaintiff's injuries. *Dixon*, at 362. The court's opinion states: "To construe [NRS 455.010] otherwise would be to impose a continuing responsibility upon persons who may well have lost all right, authority and power to meet such responsibility. Such cannot have been the legislative
intent." *Id*.

This holding clearly supports the Abandoned Mine Lands Program's reliance on the legislative exception to the waiver of sovereign immunity in NRS 41.0331 and clarifies the object of the duty to safeguard hazardous conditions found in NRS 455.010. Those who dig a shaft or thereafter abandon it have an absolute duty to safeguard open excavations. The duty does not continue to run to subsequent possessors; however, landowners may be ultimately responsible for dangerous conditions such as abandoned shafts, excavations, or other hazards where the landowner knew or should have known that the failure to guard or warn would very probably cause injury.[22]

[22] In 1990, the Ninth Circuit decided a case in which they reinterpreted Nevada law regarding the definition of "willfulness." *McMurray v. U.S.*, 918 F.2d 834 (9th Cir. 1990); *but see Gard v. U.S.*, 594 F.2d 1230, 1233 (9th Cir. 1979) ("willfulness under Nevada law means there must be design, purpose and intent to do wrong and inflict the injury, *citing Crossman v. So. Pacific Co.*, 44 Nev. 286, 194 P. 839 (1921)). Plaintiff, aged two, had been severely burned in a naturally flowing hot spring of 160° - 180° near Fallon, Nevada. Plaintiff sued BLM (landowner) for willful failure to warn or guard against a dangerous condition. See NRS 41.510(3)(a). The trial judge awarded plaintiff $718,000; BLM appealed. The sole issue on appeal was whether BLM's failure to warn plaintiff of dangerous conditions at the hot spring was "willful." They held that the Nevada Supreme Court in *Davies v. Butler*, 95 Nev. 763, 602 P.2d 605 (1979) subsequent to the Ninth Circuit's holding in *Gard v. U.S.*, had redefined "willfulness" to remove any requirement of intent to injure and now defined willful misconduct as "intentional wrongful conduct done with the knowledge that serious harm to another will probably result." *McMurray*, 918 F.2d at 837.

Even though the duty to safeguard open excavations does not continue to run to subsequent possessors, once the Division identifies and ranks a dangerous condition at an abandoned mine site and proceeds to fence it, then the question of whether NRS 41.510 (the recreational use statute) provides immunity still remains. Almost all the states have passed laws limiting landowner liability for those lands used for recreational activities. *Barrett, Good Sports & Bad Lands: The Application of Washington's Recreational Use Statute Limiting Landowner Liability*, 53 Wash. L. Rev. 1 (1977). Most of these laws are derived from a model act promulgated in 1965 by the Council of State Governments. The Model Act was drafted to encourage private landowners to open their land to recreational users. Those acts which do not specify whether public entities are covered or do not define "owner" must be construed by the courts utilizing the legislative history for a determination. Nevada's act (NRS 41.510) was passed in 1963; however, there is no legislative history from the 1963 session to indicate whether it was derived from the Model Act, nor does it specifically include public entities. The Legislative Counsel Bureau did not begin transcribing and reporting testimony before the committees until 1965. Nevertheless because approximately 87 percent of Nevada is public land it is probable that the act included public entities within its coverage. (*See* footnote 3).

The courts have applied NRS 41.510 to federal landowners in Nevada in the past. *Gard v. U.S.*, 594 F.2d 1230 (9th Cir. 1979) (BLM not liable for personal injuries following plaintiff's fall into an unguarded mine shaft); *McMurray v. U.S.*, 918 F.2d 834 (9th Cir. 1990) (BLM liability based on Federal Tort Claims Act *and* the Nevada Recreational Use Statute, NRS 41.510); *Ducey v. U.S.*, 713 F.2d 504 (9th Cir. 1983) (*reversed* and *remanded*; on subsequent appeal from the district court's decision again in favor of the U.S. Park Service, the court found the Park Service to be under duty to warn recreational users of flood plain of hazards of major 100-year flood. *Ducey v. U.S.*, 830 F.2d 1071 (9th Cir. 1987)). There is no case applying NRS 41.510 to the state or its political subdivisions. The statute does not specifically include the state or counties within its coverage and there is no state or federal case directly applying NRS 41.510 to the state or county.[23]

If the Division or county is not the owner or lessee of the site being fenced they must fit within the definition of "occupant" to come within the coverage of NRS 41.510. The Nevada Supreme Court has construed NRS 41.510 in only one case since enactment in 1963. They noted that NRS 41.510 precluded the imposition of a duty upon a sand and gravel operation near Las Vegas to protect a motorcycle rider who was injured when he crashed into the side of the company's gravel truck. *Brannan v. Nevada Rock and Gravel Co.*, 108 Nev. 23, 823 P.2d 291 (1992). The court said that an "occupier of open land owes no duty to keep premises safe . . . for recreational purposes." *Id.* at 25. The issue was whether the gravel company "possessed and controlled" the intersection thus giving rise to a duty to maintain it under the common law. *See* Restatement (Second) of Torts § 367 (1965). Without defining "occupier," the court found the record insufficient for Nevada Rock and Gravel to be an "occupier" and thus immune under NRS 41.510. Whether the state or a county can be an "occupier" and thus entitled to immunity is still an open question in Nevada.

[23] Some states' recreational use statutes expressly include public and private entities within its coverage (*see* Wash. Rev. Code Ann § 4.24.210 (West 1993) ("any public or private landowners or others in lawful possession and control . . . shall not be liable")); however, many do not, leaving the issue up to the courts. Most of the jurisdictions which have considered this issue have construed their statutes to include public as well as private entities. *Otteson v. United States*, 622 F.2d 516 (10th Cir. 1980); *Smith v. United States*, 383 F. Supp. 1076 (D. Wyo. 1974); *Dorman v. United States*, 812 F. Supp. 685 (S.D. Miss. 1993); *Palmer v. United States*, 742 F. Supp. 1068 (D. Hawaii 1990); *Page v. City of Louisville*, 722 S.W. 2nd 60 (Ky.Ct.App. 1986); *Mitchell v. Cleveland Elec. Illuminating Co.*, 507 N.E.2d 352 (Ohio 1987); *Fastow v. Burleigh County Water Resource Dist.*, 415 N.W.2d 505 (N.D. 1987); *Rodriguez v. Fireman's Fund Ins. Co.*, 449 So.2d 1042 (La.Ct.App. 1984); *Watson v. City of Omaha*, 312 N.W.2d 256 (Neb. 1981); *But see*, *Chapman v. Pinellas County*, 423 So.2d 578 (Fla. Dist. Ct. App. 1982) (Florida recreational use statute did not apply to the county where purpose of the statute was to make privately owned property available for public use.); *Hovet v. City of Bagley*, 325 N.W.2d 813 (Minn. 1982) (Minnesota recreational use statute did not apply to city owned land). *See Barrett, Good Sports and Bad Lands: The Application of Washington's Recreational Use Statute Limiting Landowner Liability*, 53 Wash. L. Rev. 1 (1977).

Other courts have grappled with the issue of who is an "occupier" in the context of recreational use statutes. One court found that a snowmobile club that groomed trails on public land owned by the U.S. Forest Service with permission of the Forest Service "occupied the trail with a degree of permanence," even though the club did not own or lease the land. *Smith v. Sno Eagles Snowmobile Club*, 823 F.2d 1193, 1197 (7th Cir. 1987). The court refused to interpret "occupant" as one in actual possession or exclusive control as that would be indistinguishable from owner and would negate the legislative intent to open up as much land as possible to recreation. *Id.* at 1198. *Accord, Mooney v. Royal Ins. Co. of America*, 476 N.W.2d 287 (Wis. Ct. App. 1991) (The court found a non-profit club liable for personal injuries following an accident on a temporary snowmobile race track on city property after finding the club not to be an occupant because "they had finished cleaning up and had left the premises with no intent to return.") Black's Law Dictionary (6th ed. 1990) defines occupant as: "Person having possessory rights, who can control what goes on the premises. One who has actual use, possession or control of a thing." Possessory rights are acquired by an owner or lessee, of course, and thus entitled to protection of the recreational use statute; however, both the *Sno Eagle* court and the *Royal Ins. Co. of America* court found more transient interests to be within the ambit of the statute. Other transient interests which made their holders "occupiers" and thus entitled to the protection of recreational use statutes include special use permits, license to construct a dam, easement holders, a livestock grazing permit and other revocable licenses.[24]

Whether the Division or the counties will be considered "occupiers" for purposes of NRS 41.510 when fencing abandoned mine sites may hinge on issues of actual use and control. Additionally, in all the cases cited, the occupiers who received the protection of the recreational use statute had a legal right to be there whether their right was a possessory interest in the land or non-possessory interest such as a license or easement. The Division's or the county's right to fence dangerous conditions on any land other than the states' must be superior to the right of the recreational user to also be there. A common law limitation on liability was provided to a possessor of land who had superior right as to a trespasser, but who may not have been the owner.25 *O'Shea v. Claude C. Wood Co.*, 97 Cal. App. 3d 903, 911 (Cal. Ct. App. 1979) ([r]ule of nonliability may be successfully invoked by one who, although not the owner of the property on which the injury occurred, had rights therein superior to those of the trespasser who was injured . . . ," *quoting* from 65 C.J.S. *Negligence* § 63(21) (1966). Whether the definition of "possessor" and "occupant" are the same for purposes of fencing dangerous conditions at abandoned mine sites is not clear, but the cases cited above say that the dispositive issues are actual use and control.

[24] The defendants in both *Sno Eagles Snowmobile Club*, and *Royal Ins. Co. of America*, had permission from the landowner to construct their respective projects. Although the cases do not say what form the permission took it is probable a permit was issued. In *Kantner v. Combustion Engineering*, 701 F. Supp. 943 (D. N.H. 1988) the court found the defendant to be an occupier based solely on construction activity pursuant to a license issued by a federal agency. The court focused on "possession and actual use of the premises" in defining "occupier." The California Supreme Court in *Hubbard v. Brown*, 50 Cal.3d 189, 785 P.2d 1183 (Cal. 1990) found that the holder of a permit to graze livestock on federal lands had sufficient interest in the land to be immune from liability under California's recreational use statute. The California statute, Civil Code § 846, was amended in 1980 to include any interest in land whether possessory or non- possessory. *Hubbard*, 50 Cal.3d at 194. The court said the amendment clearly meant to immunize private owners of easements and revocable licenses from tort liability to recreational users. *Id.* at 197. Please note that California's statute, § 846, was held by the California Supreme Court not to apply to public entities because it is irreconcilable with the provisions of the Tort Claims Act also dealing with recreational users of property. *Delta Farms Reclamation Dist. v. Superior Court*, 33 Cal.3d 699, 660 P.2d 1168 (Cal. 1983). In 1983, the California legislature amended the Tort Claims Act in response to *Delta Farms* and enacted a statute substantially similar to § 846 which expressly incorporates public entities and employees thus immunizing them from liability to recreational users. Government Code § 831.7.

[25] Restatement (Second) of the Law § 328E (1985) defines "Possessor of Land" as "(a) a person who is in occupation of the land with intent to control it."

Because fencing a dangerous condition is a clear indication of actual use and intent to control the premises, I conclude that fencing with the permission of the owner is sufficient to make one an occupant. NRS 41.510.

Other limitations on the state's waiver of sovereign immunity from civil actions based on discretionary acts of its employees as found in NRS 41.032 may not be applicable to the Division's program for fencing abandoned mine sites.[26] Discretionary acts or decisions are those typically made pursuant to policy such as whether or not to construct a controlled access highway. *State v. Webster*, 88 Nev. 690, 693, 504 P.2d 1316 (1972); *Nevada Power v. Clark Co.*, 107 Nev. 428, 429, 813 P.2d 477 (1991) (Municipality's decision not to place a traffic signal at a dangerous intersection is a discretionary act for which it is immune from liability). These cases also hold that once a decision to construct a highway or traffic signal is made, there attaches an obligation to use due care to make it reasonably safe for those who use it. The Division's decisions made when ranking the degree of hazardous conditions at abandoned mine sites are discretionary determinations based on standards issued by the Commission on Mineral Resources, but actual construction of a fence is also protected by NRS 41.0331 which provides immunity for *any act or omission* in constructing a fence; therefore it appears the legislature has given the Division immunity for acts of negligence even when constructing the fence.

CONCLUSION

Fencing done in the manner prescribed by regulation does satisfy the state's statutory requirements as found in NRS 455.010, *et seq.* and NRS 513.073, *et seq.* The Division or county may rely on the immunity protections found in NRS 41.510 and NRS 41.0331 when abandoned mine sites are fenced pursuant to permission or agreement with the landowner which gives the Division or county superior rights to occupy the site as to third parties.

Sincerely,

FRANKIE SUE DEL PAPA
Attorney General

By: GEORGE H. TAYLOR
Deputy Attorney General

Proposed Legislative / Administrative Actions

Proposed Species Classification Changes for Nevada

The following table lists State Classification Changes as recommended by the Nevada Bat Working Group. All information was adapted from the following sources:

- 'Western Bat Species - Regional Priority Matrix' Western Bat Working Group, 1998.
- Literature citations from the Nevada Bat Conservation Plan.
- Nevada Natural Heritage Program Database, 2001.
- Local Bat Professionals.
- U.S. Fish and Wildlife Service, Proposed Rule, Endangered and Threatened Taxa, 50CFRPart 17.

Species	Current State Status	Recommended State Classification Change	Justification Criteria	
			NAC 503.103	NAC 503.104
Mexican long-tongued bat	Unprotected	Protected	2, 3, 4, 6	4
California leaf-nosed bat	Sensitive	No Change	2, 4, 5, 6	1, 3, 4
pallid bat	Protected	No Change	4, 6	4
Townsend's big-eared bat	Sensitive	No Change	2, 3, 4, 5, 6, 7	1, 2, 3, 4
big brown bat	Unprotected	Protected	4	4
spotted bat	Threatened	No Change	6	4
Allen's big-eared bat	Protected	No Change	4, 6	1, 4
silver-haired bat	Unprotected	Protected	4	NA
western red bat	Sensitive	No Change	2, 3, 4, 5	2, 3
hoary bat	Unprotected	Protected	4, 5	NA
western yellow bat	Unprotected	Protected	2, 4, 5	NA
California myotis	Unprotected	Protected	4	NA
western small-footed myotis	Unprotected	Protected	4, 6	4
long-eared myotis	Unprotected	Protected	4, 6, 7	4
little brown myotis	Unprotected	Protected	4	4
fringed myotis	Protected	No Change	4, 6	4
cave myotis	Unprotected	Protected	2, 4, 5, 6	4
long-legged myotis	Unprotected	Protected	4, 6, 7	4
Yuma myotis	Unprotected	Protected	4, 6	4
western pipistrelle	Unprotected	Protected	4	NA
western mastiff bat	Sensitive	No Change	4, 6	4
big free-tailed bat	Unprotected	Protected	4, 6, 7	4
Brazilian Free-tailed Bat	Protected	No Change	3, 4, 6, 7	4

The following state classification criteria were obtained from Nevada Administrative Code (NAC) 503, Updated November, 2005:

NAC 503.103 Criteria for classification of wildlife as protected. A species or subspecies of wildlife may be further classified as protected if the division (wildlife) determines, from available information, that *one or more* of the following criteria exists:

1. The wildlife is found only in this state (Nevada) and its population, distribution or habitat is limited.
2. The wildlife has a limited population or distribution within this state that is likely to decline as a result of human or natural causes.
3. The population of the wildlife is threatened as a result of the deterioration or loss of its habitat.
4. The wildlife has ecological, scientific, educational or other value that justifies its classification as protected.
5. The available data is not adequate to determine the exact status of the population of the wildlife, but does indicate a limited population, distribution, or habitat.
6. The wildlife is listed by the United States Fish and Wildlife Service in the Federal Register as a Category 1, 2 or 3 species, or it is classified as threatened or endangered in the federal Endangered Species Act of 1973, as amended.
7. Other evidence exists to justify classifying the wildlife as protected.

(Added to NAC by Board of Wildlife Commissioners, effective 7-6-92)

NAC 503.104 Criteria for classification of wildlife as sensitive. A species or subspecies of wildlife may be further classified as sensitive if the division determines, from available information, that one or more of the following criteria exists:

1. The population or distribution of the wildlife is in a significant decline.
2. The population of the wildlife is threatened as a result of disease or predation or ecological or human causes.
3. The primary habitat of the wildlife is deteriorating.
4. The wildlife is listed by the United States Fish and Wildlife Service in the Federal Register as Category 1, 2 or 3 species, or it is classified as threatened or endangered in the federal Endangered Species Act of 1973, as amended.

(Added to NAC by Board of Wildlife Commissioners, effective 7-6-92)

Current Agency Designations for Bats Occurring in Nevada:

Scientific Name	Common Name	USFWS	BLM	USFS	State	Grank	Srank
Choeronycteris mexicana	Mexican long-tongued bat	xC2				G4	SA
Macrotus californicus	California leaf-nosed bat	xC2	N,C	C	Sensitive	G4	S2
Antrozous pallidus	pallid bat		N,C	I	Protected	G5	S3
Corynorhinus townsendii	Townsend's big-eared bat	xC2	N,C	S,I,L	Sensitive	G4	S2
Eptesicus fuscus	big brown bat		N			G5	S4
Euderma maculatum	spotted bat	xC2	S	S	Threatened	G4	S2
Idionycteris phyllotis	Allen's big-eared bat	xC2	N		Protected	G3G4	S1
Lasionycteris noctivagans	silver-haired bat		N			G5	S3
Lasiurus blossevillii	western red bat		N	I	Sensitive	G5	S1
Lasiurus cinereus	hoary bat		N			G5	S3
Lasiurus xanthinus	western yellow bat					G5	S1
Myotis californicus	California myotis		N			G5	S4
Myotis ciliolabrum	western small-footed myotis	xC2	N,C			G5	S3
Myotis evotis	long-eared myotis	xC2	N,C			G5	S4
Myotis lucifugus	little brown bat		N			G5	S3
Myotis thysanodes	fringed myotis	xC2	N,C		Protected	G4G5	S2
Myotis velifer	cave myotis	xC2	N,C			G5	S1
Myotis volans	long-legged myotis	xC2	N			G5	S4
Myotis yumanensis	Yuma myotis	xC2	N,C			G5	S3S4
Pipistrellus hesperus	western pipistrelle		N			G5	S4
Eumops perotis	greater western mastiff bat	xC2	N,C		Sensitive	G5	S1
Nyctinomops macrotis	big free-tailed bat	xC2	N			G5	S1S2
Tadarida brasiliensis	Brazilian free-tailed bat		N		Protected	G5	S3S4

U. S. Fish and Wildlife Service (**USFWS**) Categories for Listing under the Endangered Species Act:

- <C2 Former USFWS Category 2 Candidate, now species of concern

Bureau of Land Management (**BLM**) Species Classification:

- S Nevada Special Status Species - USFWS listed, proposed or candidate for listing, or protected by Nevada state law
- N Nevada Special Status Species - designated Sensitive by State Office
- C California Special Status Species (see definition S and N)

United States Forest Service (**USFS**) Species Classification:

- S Region 4 (Humboldt-Toiyabe NF) sensitive species
- I Region 5 (Inyo NF) sensitive species
- L Region 5 (Lake Tahoe Basin Management Unit) sensitive species
- C Region 5 sensitive species, not yet known from Inyo NF or Lake Tahoe Basin Management Unit

Nevada Natural Heritage Program Global (**Grank**) and State (**Srank**) Ranks for Threats and/or Vulnerability:

- G Global rank indicator, based on worldwide distribution at the species level
- T Global trinomial rank indicator, based on worldwide distribution at the subspecific level
- S State rank indicator, based on distribution within Nevada at the lowest taxonomic level
  - I Critically imperiled and especially vulnerable to extinction or extirpation due to extreme rarity, imminent threats, or other factors
  - 2 Imperiled due to rarity or other demonstrable factors
  - 3 Vulnerable to decline because rare and local throughout its range, or with very restricted range
  - 4 Long-term concern, though now apparently secure; usually rare in parts of its range, especially at its periphery
  - 5 Demonstrably secure, widespread, and abundant
    - A Accidental within Nevada
    - B Breeding status within Nevada (excludes resident taxa
    - H Historical; could be rediscovered
    - N Non-breeding status within Nevada (excludes resident taxa)

Western Bat Working Group

Regional Bat Species Priority Matrix

The Western Bat Species: Regional Priority Matrix is a product of the Western Bat Working Group Workshop held in Reno, Nevada, February 9-1 3, 1998. The matrix is intended to provide states, provinces, federal land management agencies, and interested organizations and individuals a better understanding of the overall status of a given bat species throughout its western North American range. Subsequently, the importance of a single region or multiple regions to the viability and conservation of each species becomes more apparent. The matrix should also provide a means to prioritize and focus population monitoring, research, conservation actions, and the efficient use of limited funding and resources currently devoted to bats.

The following descriptors provide the information needed to interpret the Western Bat Species: Regional Priority Matrix.

RED OR HIGH: Based on available information on distribution, status, ecology, and known threats, this designation should result in these species being considered the highest priority for funding, planning, and conservation actions. Information about status and threats to most species could result in effective conservation actions being implemented should a commitment to management exist. These species are imperiled or are at high risk of imperilment.

YELLOW OR MEDIUM: This designation indicates a level of concern that should warrant closer evaluation, more research, and conservation actions of both the species and possible threats. A lack of meaningful information is a major obstacle in adequately assessing these species' status and should be considered a threat.

GREEN OR LOW: This designation indicates that most of the existing data support stable populations of the species, and that the potential for major changes in status in the near future is considered unlikely. While there may be localized concerns, the overall status of the species is believed to be secure. Conservation actions would still apply for these bats, but limited resources are best used on red and yellow species.

P PERIPHERY: This designation indicates a species on the edge of its range. This designation was utilized by only one region and reflects neither high, medium, nor low concern.

The map and matrix regions were derived from R.G. Bailey's Ecoregions of the United States (revised 1994) by pooling at the province level of the hierarchical structure to produce a

workable, but ecologically meaningful, number of regions for analysis and discussion at the Western Bat Working Group Workshop.

In some instances, regions were combined when the number of workshop participants were too few to provide information on the distribution, status, ecology, and known threats to bats in the respective regions.

Research And Management Needs

Research and management needs, recommended as high priority by the majority of regional analysis groups, fell into five general areas:

- The need for standardized sampling recognizing that population status and trend data are lacking and seriously needed for most species;
- Monitoring the effectiveness of management actions implemented for bat conservation;
- Assessing the effects of contaminants on migratory bat species;
- Information on roosting requirements, foraging ecology, and seasonal movement patterns; and
- The need to gain a regional perspective and more complete distributional information, especially in relation to longitude, latitude, elevation, and habitat types for most species.

  As a means to accomplishing the latter, two groups suggested establishing a summer censusing program analogous to the Christmas bird count. As a result, a 'National Bat Survey Week" will be initiated by the WBWG with the intention of promoting the need to obtain bat data from mist netting efforts by appropriately trained researchers, managers, and biologists across the U.S. The second full week of August each year will be considered "National Bat Survey Week." It will be a targeted time period for emphasis on conducting bat surveys. State bat working groups are encouraged to help promote, coordinate, and facilitate state efforts, and identify locations for surveys.

Multiple Habitat Bats

SPECIES	REGION 1	REGION 2	REGIONS 3,4,9,& 10	REGION 5	REGION 6	REGIONS 7 & 8
Southwestern myotis ***Myotis auriculus***	X	X	X	X	X	
California myotis ***Myotis californicus***						
western small-footed Myotis ***Myotis ciliolabrum***	P				+	
Long-eared myotis ***Myotis evotis***					-	
Keen's myotis ***Myotis keenii***		X	X	X	X	X

Little brown bat ***Myotis lucifigus***						
Arizona myotis ***Myotis occultus***	X	X	X	X	X	
Northern myotis ***Myotis septentrionalis***	X	X		X	X	X
Fringed myotis ***Myotis thysanodes***			+			
Long-legged myotis ***Myotis volans***						
Yuma myotis ***Myotis yumanensis***					-	
Big brown bat ***Eptesicus fuscus***						
Lappet-eared bat ***Idionycteris phyllotis***	X	X	X	X		
Pallid bat ***Antrozous pallidus***						
Brazilian free-tailed bat ***Tadarida brasiliensis***		X			-	

Tree - Roosting Bats

SPECIES	REGION 1	REGION 2	REGIONS 3,4,9,& 10	REGION 5	REGION 6	REGIONS 7 & 8
western red bat ***Lasiurus blossevillii***	X	X	X			
Eastern red bat ***Lasiurus borealis***	X	X		X	X	X
Hoary bat ***Lasiurus cinereus***						
western yellow bat ***Lasiurus xanthinus***	X	X	X		X	
Silver-haired bat ***Lasionycteris noctivagans***			+			

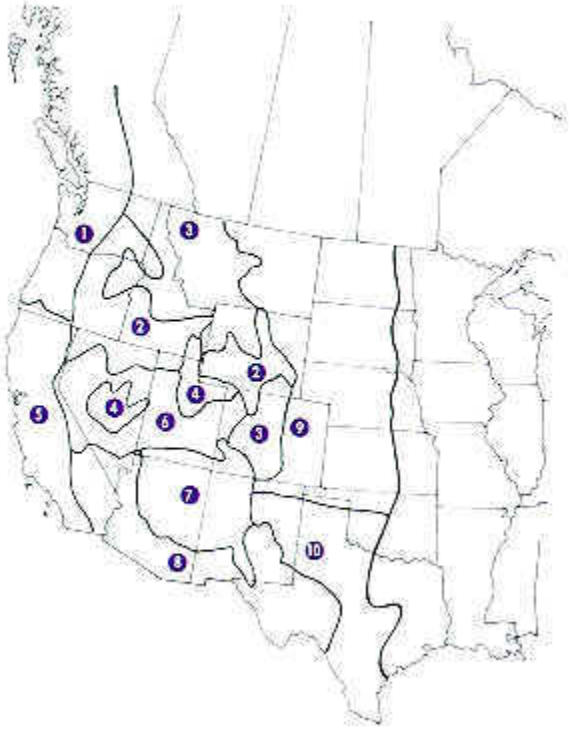
Cliff - Roosting Bats

SPECIES	REGION 1	REGION 2	REGIONS 3,4,9,& 10	REGION 5	REGION 6	REGIONS 7 & 8
western pipistrelle ***Pipistrellus hesperus***	P					
Spotted bat ***Euderma maculatum***	P					
Pocketed free-tailed bat ***Nyctinomops femorosaccus***	X	X	X		X	
Big free-tailed bat ***Nyctinomops macrotis***	X	X				
western mastiff bat ***Eumops perotis***	X	X	X			
Underwood's mastiff bat ***Eumops underwoodi***	X	X	X	X	X	

Cave - Roosting Bats

SPECIES	REGION 1	REGION 2	REGIONS 3,4,9,& 10	REGION 5	REGION 6	REGIONS 7 & 8
Ghost-faced bat ***Mormoops megalophylla***	X	X	X	X	X	
California leaf-nosed bat ***Macrotus californicus***	X	X	X		X	
Mexican long-tongued bat ***Choeronycteris mexicana***	X	X	X		X	
Lesser long-nosed bat ***Leptonycteris curasoae***	X	X	X	X	X	
Big long-nosed bat ***Leptonycteris nivalis***	X	X	X	X	X	
Cave myotis ***Myotis velifer***	X	X		X	X	
Townsend's big-eared bat ***Corynorhinus***						

Map of Ecoregions Used In Priority Matrix



From:

Bailey's Ecoregions of the United States (revised 1994)

Proposed Changes to the Scientific Collection Permit (NRS 503.650) Addendum Specific to Bats

Permit Requirement

Prior to application to the Nevada Department of Wildlife for a Scientific Collection Permit to handle and capture bats, applicants must:

1. Accrue at least 40 hours of bat surveys with a currently permitted bat biologist (travel hours excluded). These hours must include, at least, instruction in the methods of study the permittee intends to use under his/her permit request. A person holding a state scientific collection permit in Nevada or another state is, in this context, a "permitted bat biologist".
2. Provide proof of #1 with permit application, including contact information for the permitted bat biologist.
3. Sign and date acknowledgement that applicant has read and understands, and will to the best of his/her ability abide by the ethical conduct outlined in the *Nevada Bat Survey Protocol* and the pending *Nevada Cave Protection Act* found in the *Nevada Bat Conservation Plan*.

Following presentation by the Nevada Department of Wildlife of a Scientific Collection Permit to a qualified bat biologist, the biologist must:

1. Follow all permit stipulations, with no exception:
    a. Provide acoustic voucher specimens when possible and appropriate.
    b. Voucher collection inside roosts is strictly prohibited, unless direct permission is included in the permit.
    c. Use non-intrusive survey methods (e.g., acoustic, passive, infrared night vision, infrared video) whenever possible and appropriate.
    d. Coordinate with local NDOW Wildlife Diversity Bureau biologists prior to fieldwork to eliminate duplication of effort and undue stress on bat populations.
    e. Provide all data in a digital format to the Nevada Department of Wildlife, Wildlife Diversity Bureau, 1100 Valley Road, Reno, Nevada 89512-2817, 775-688-1500.
    f. Provide all locations, including roost locations in NAD 27 UTMs, Zone 11.
    g. Provide report within 30 days of permit expiration date.
    h. Do not publish exact roost locations in any external agency reports, or peer-reviewed technical and popular literature. Locations down to the nearest Township and Range, the nearest ten-thousand meter UTM, or the general area (mountain range or valley name) are allowable.
    i. Provide a copy of all pertinent research, technical and popular literature to the Department.

Also, it is suggested that permitted biologists use the accepted acoustic and capture bat survey form data sheets found in the survey protocol section of the Nevada Bat Conservation Plan, when appropriate, so as to facilitate data sharing between wildlife professionals.

Failure to follow any/all permit stipulations will result in permit revocation and/or non-renewal of future Scientific Collection Permit applications in Nevada.

Proposed Language for the Nevada Cave Protection Act

(Drafted from Arizona Legislation)

This is a proposed first step towards the creation of a Nevada Cave Protection Act, recognizing that refinement and more detail will be written into a final legistalative action.

Nevada Cave Protection Act NRS 000.000 Defacing or damaging petroglyphs, pictographs, caves or caverns; classification

Section A.
A person commits defacing or damaging of caves or caverns, or disturbs plant life therein without the prior written permission of the land owner/manager; or disturbs animal life therein without the prior written permission from the Nevada Department of Wildlife (i.e., through the Scientific Collection Permit process), if such a person knowingly:

1. Breaks, breaks off, cracks, carves upon, writes or otherwise marks upon or in any manner destroys, mutilates, injures, defaces, removes, displaces, mars or harms petroglyphs, pictographs or any natural material found in any cave or cavern; or
2. Kills, harms or disturbs plant or animal life found in any cave or cavern, except for safety reasons; or
3. Disturbs or alters the natural condition of such petroglyph, pictograph, cave or cavern or takes into a cave or cavern any aerosol or other type of container containing paints, dyes or other coloring agents; or
4. Breaks, forces, tamper with, remove or otherwise disturb a lock, gate, door or other structure or obstruction designed to prevent entrance to a cave or cavern whether or not entrance is gained.
5. Breaks, forces, tamper with, remove or otherwise disturb interpretive information associated with the cave or cavern.

Section B.
As used in this section, "natural material" means stalactites, stalagmites, helictites, anthodites, gypsum flowers or needles, flowstone, draperies, columns, tufa dams, clay or mud formations or concretions or other similar crystalline mineral formations found in any cave or cavern.

Section C.
Defacing or damaging petroglyphs, pictographs, caves, caverns, or plant or animal life found within any cave or cavern, except for safety reasons is a Class 2 misdemeanor.

Federal Cave Resources Protection Act of 1988 (Summary)

Provided for reference only.

Federal Cave Resources Protection Act (1988)

Act of November 18, 1988 (P.L. 100-691; 102 Stat. 4546; 16 U.S.C. 4301-4309)

BE IT ENACTED BY THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED

SEC. 1. SHORT TITLE.
This Act may be referred to as the "Federal Cave Resources Protection Act of 1988."

SEC. 2. FINDINGS, PURPOSES, AND POLICY.
(a) FINDINGS.-The Congress finds and declares that:

(1) significant caves on Federal lands are an invaluable and irreplaceable part of the Nation's natural heritage; and

(2) in some instances, these significant caves are threatened due to improper use, increased recreational demand, urban spread, and a lack of specific statutory protection.

(b) PURPOSES.-The purposes of this Act are:

(1) to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people; and

(2) to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on Federal lands for scientific, education, or recreational purposes.

(c) POLICY.-It is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves.

SEC. 3. DEFINITIONS.

For purposes of this Act:
(1) CAVE.- The term "cave" means any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other man-made excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or man-made. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance.

(2) FEDERAL LANDS.- The term "Federal lands" means lands the fee title to which is owned by the United States and administered by the Secretary of Agriculture or the Secretary of the Interior.

(3) INDIAN LANDS.- The term "Indian lands" means lands of Indian tribes or Indian individuals which are either held in trust by the United States for the benefit of an Indian tribe or subject to a restriction against alienation imposed by the United States.

(4) INDIAN TRIBE.- The term "Indian tribe" means any Indian tribe, band, nation, or other organized group or community of Indians, including any Alaska Native village or regional or village corporation as defined in, or established pursuant to, the Alaska Native Claims Settlement Act (43 U.S.C 1601 et seq.).

(5) CAVE RESOURCE.- The term "cave resource" includes any material or substance occurring naturally in caves on Federal lands, such as animal life, plant life, paleontological deposits, sediments, minerals, speleogens, and speleothems.

(6) SECRETARY.- The term "Secretary" means the Secretary of Agriculture or the Secretary of the Interior, as appropriate.

(7) SPELEOTHEM.- The term "speleothem" means any natural mineral formation or deposit occurring in a cave or lava tube, including but not limited to any stalactite, stalagmite, helictite, cave flower, flowstone, concretion, drapery, rimstone, or formation of clay or mud.

(8) SPELEOGEN.- The term "speleogen" means relief features on the wails, ceiling, and floor of any cave or lava tube which are part of the surrounding bedrock, including but not limited to anastomoses, scallops, meander niches, petromorphs and rock pendants in solution caves and similar features unique to volcanic caves.

SEC. 4. MANAGEMENT ACTIONS.

(a) REGULATIONS-Not later than nine months after the date of the enactment of this Act, the Secretary shall issue such regulations as he deems necessary to achieve the purposes of this Act. Regulations shall include, but not be limited to, criteria for the identification of significant caves. The Secretaries shall cooperate and consult with one another in preparation of the regulations. To the extent practical, regulations promulgated by the respective Secretaries should be similar.

(b) IN GENERAL-The Secretary shall take such actions as may be necessary to further the purposes of this Act. These actions shall include (but not be limited to:

(1) identification of significant caves on federal lands;

(A) The Secretary shall prepare an initial list of significant caves for lands under his jurisdiction not later than one year after the publication of final regulations using the significance criteria defined in such regulations. Such a list shall be developed after consultation with appropriate private sector interests, including cavers.

(B) The initial list of significant caves shall be updated periodically, after consultation with appropriate private sector interests, including cavers. The Secretary shall prescribe by policy or regulation the requirements and process by

which the initial list will be updated, including management measures to assure that caves under consideration for the list are protected during the period of consideration. Each cave recommended to the Secretary by interested groups for possible inclusion on the list of significant caves shall be considered by the Secretary according to the requirements prescribed pursuant to this paragraph, and shall be added to the list if the Secretary determines that the cave meets the criteria for significance as defined by the regulations.

(2) regulation or restriction of use of significant caves, as appropriate;

(3) entering into volunteer management agreements with persons of the scientific and recreational caving community; and

(4) appointment of appropriate advisory committees.

(c) PLANNING AND PUBLIC PARTICIPATION.-The Secretary shall-

(1) ensure that significant caves are considered in the preparation or implementation of any land management plan if the preparation or revision of the plan began after the enactment of this Act;

(2) foster communication, cooperation, and exchange of information between land managers, those who utilize caves, and the public.

SEC. 5. CONFIDENTIALITY OF INFORMATION CONCERNING NATURE AND LOCATION OF SIGNIFICANT CAVES.

(a) IN GENERAL.-Information concerning the specific location of any significant cave may not be made available to the public under section 552 of title 5, United States Code, unless the Secretary determines that disclosure of such information would further the purposes of this Act and would not create a substantial risk of harm, theft, or destruction of such cave.

(b) EXCEPTIONS.-Not withstanding subsection (a), the Secretary may make available information regarding significant caves upon the written request by Federal and state governmental agencies or bona fide educational and research institutions. Any such written request shall, at a minimum:

(1) describe the specific site or area for which information is sought;

(2) explain the purpose for which such information is sought; and

(3) include assurances satisfactory to the Secretary that adequate measures are being taken to protect the confidentiality of such information and to ensure the protection of the significant cave from destruction by vandalism and unauthorized use.

SEC. 6, COLLECTION AND REMOVAL FROM FEDERAL CAVES.

(a) PERMIT.-The Secretary is authorized to issue permits for the collection and removal of cave resources under such terms and conditions as the Secretary may impose, including the posting of bonds to insure compliance with the provisions of any permit.

(1) Any permit issued pursuant to this section shall include information concerning the time, scope, location, and specific purpose of the proposed collection, removal or associated activity, and the manner in which such collection, removal, or associated activity is to be performed must be provided.

(2) The Secretary may issue a permit pursuant this subsection only if he determines that the proposed collection or removal activities are consistent with the purposes of this Act and with other applicable provisions of law.

(b) REVOCATION OF PERMIT.-Any permit issued under this section shall be revoked by the Secretary upon a determination by the Secretary that the permittee has violated any provision of this Act, or has failed to comply with any other condition upon which the permit was issued. Any such permit shall be revoked by the Secretary upon assessment of a civil penalty against the permittee pursuant to section 8 or upon the permittee's conviction under section 7 of this Act. The Secretary may refuse to issue a permit under this section to any person who has violated any provision of this Act or who has failed to comply with any condition of a prior permit.

(c) TRANSFERABILITY OF PERMITS. Permits issued under this act are not transferable.

(d) CAVE RESOURCES LOCATED ON INDIAN LANDS.-

(1)(A) Upon application by an Indian tribe, the Secretary is authorized to delegate to the tribe all authority of the Secretary under this section with respect to issuing and enforcing permits for the collection or removal of any cave resource located on the affected Indian lands.

(B) In the case of any permit issued by the Secretary for the collection or removal of any cave resource, or to carry out activities associated with such collection or removal, from any cave resource located on Indian lands (other than permits issued pursuant to subparagraph (A), the permit may be issued only after obtaining the consent of the Indian or Indian Tribe owning or having jurisdiction over such lands. The permit shall include such reasonable terms and conditions as may be requested by such Indian or Indian Tribe.

(2) If the Secretary determines that the issuance of a permit pursuant to this section may result in harm to, or destruction of, any religious or cultural site, the Secretary, prior to issuing such permit, shall notify any Indian tribe which may consider the site as having significant religious or cultural importance. Such notice shall not be deemed a disclosure to the public for purposes of section 5.

(3) A permit shall not be required under this section for the collection or removal of any cave resource located on Indian lands or activities associated with such collection, by the Indian or Indian tribe owning or having jurisdiction over such lands.

(e) EFFECT OF PERMIT-No action specifically authorized by a permit under this section shall be treated as a violation of section 7.

SEC. 7 PROHIBITED ACTS AND CRIMINAL PENALTIES.

(a) PROHIBITED ACTS.-

(1) Any person who, without prior authorization from the Secretary knowingly destroys, disturbs, defaces, mars, alters, removes or harms any significant cave or alters the free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intention of committing any act described in this paragraph shall be punished in accordance with subsection (b).

(2) Any person who possesses, consumes, sells, barters or exchanges, or offers for sale, barter or exchange, any cave resource from a significant cave with knowledge or reason to know that such resource was removed from a significant cave located on Federal lands shall be punished in accordance with subsection (b)

(3) Any person who counsels, procures, solicits, or employs any other person to violate any provisions of this subsection shall be punished in accordance with subsection (b).

(4) Nothing in this section shall be deemed applicable to any person who was in lawful possession of a cave resource from a significant cave prior to the date of enactment of this Act.

(b) PUNISHMENT:-The punishment for violating any provision of subsection (a) shall be imprisonment of not more than one year or a fine in accordance with the applicable provisions of title 18 of the United States Code, or both. In the case of a second or subsequent violation, the punishment shall be imprisonment of not more than 3 years or a fine in accordance with the applicable provisions of title 18 of the United States Code, or both.

SEC. 8. CIVIL PENALTIES.

(a) ASSESSMENT.-

(1) The Secretary may issue an order assessing a civil penalty against any person who violates any prohibition contained in this Act, any regulation promulgated pursuant to this Act, or any permit issued under this Act. Before issuing such an order, the Secretary shall provide such person written notice and the opportunity to request a hearing on the record within 30 days. Each violation shall be a separate offense, even if such violations occurred at the same time.

(2) The amount of such civil penalty shall be determined by the Secretary taking into account appropriate factors, including

(A) the seriousness of the violation;
(B) the economic benefit (if any) resulting from the violation;
(C) any history of such violations; and
(D) such other matters as the Secretary deems appropriate. The maximum fine permissible under this section is $10,000.

(b) JUDICIAL REVIEW.-Any person aggrieved by an assessment of a civil penalty under this section may file a petition for judicial review of such assessment with the United States District Court for the District of Columbia or for the district in which the violation occurred. Such a petition shall be filed within the 30-day period beginning on the date the order assessing the civil penalty was issued.

(c) COLLECTION-If any person fails to pay an assessment of a civil penalty-

> (1) within 30 days after the order was issued under subsection (a), or
> (2) if the order is appealed within such 30 day period, within 10 days after the court has entered a final judgment in favor of the Secretary under subsection (b), the Secretary shall notify the Attorney General and the Attorney General shall bring a civil action in an appropriate United States district court to recover the amount of penalty assessed (plus costs, attorneys fees, and interest at currently prevailing rates from the date the order was issued or the date of such final judgment, as the case may be). In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review.

(d) SUBPOENAS.-The Secretary may issue subpoenas in connection with proceedings under this subsection compelling the attendance and testimony of witnesses and subpoenas duces tecum, and may request the Attorney General to bring an action to enforce any subpoena under this section. The district courts shall have jurisdiction to enforce such subpoenas and impose sanctions.

SEC 9. MISCELLANEOUS PROVISIONS.

(a) AUTHORIZATION.-There are authorized to be appropriated $100,000 to carry out the purposes of this Act.

(b) EFFECT ON LAND MANAGEMENT PLANS. -Nothing in this act shall require the amendment or revision of any land management plan, the preparation of which began prior to the enactment of this Act.

(c) FUND-Any money collected by the United States as permit fees for collection and removal of cave resources; received by the United States as a result of the forfeiture of a bond or other security by a permittee who does not comply with the requirements of such permit issued under section 7; or collected by the United States by way of civil penalties or criminal fines for violations of this Act shall be placed in a special fund in the Treasury. Such moneys shall be available for obligation or expenditure (to the extent provided for in advance in appropriation Acts) as determined by the Secretary for the improved management, benefit, repair, or restoration of significant caves located on Federal lands.

(d) Nothing in this act shall be deemed to affect the full operation of the mining and mineral leasing laws of the United States, or otherwise affect valid existing rights.

SEC. 10. SAVINGS PROVISIONS.

(a) WATER.-Nothing in this Act shall be construed as authorizing the appropriation of water by any Federal, State, or local agency, Indian tribe, or any other entity or individual. Nor shall any provision of this Act-

(1) affect the rights or jurisdiction of the United States, the States, Indian tribes, or other entities over water of any river or stream or over any groundwater resource;

(2) alter, amend, repeal, interpret, modify, or be in conflict with any interstate compact made by the States; or

(3) alter or establish the respective rights of States, the United States, Indian tribes, or any person with respect to any water or water-related right.

(b) FISH AND WILDLIFE.-Nothing in this Act shall be construed as affecting the jurisdiction or responsibilities of the States with respect to fish and wildlife.

APPENDIX C

Guidelines for the Protection of Bat Roosts (Summary)

1. Do not reveal exact locations of bat roosts in technical and popular literature. Township and Range or UTMs averaged to the nearest 10,000 are acceptable.
2. Do not enter bat roosts while bats are present*.
3. Whenever possible, do not collect bats in or near entrances*.
4. Do not allow the destruction of bat roosts. Whenever possible, in mines and caves, use bat friendly gates to secure and protect roosts.
5. Do not allow the destruction of water sources near bat roosts.
6. Do not allow the destruction of bat foraging habitats near roosts.
7. Do not allow or conduct scientific investigations of bats without obtaining proper permits.
8. Do not use firearms, open-flame torches or toxicants near or in roosts.
9. Educate the public about the benefits of bats.
10. Coordinate with Nevada Department of Wildlife personnel regarding internal roost surveys.

*Some protocol exceptions.








APPENDIX D:

Resolution Concerning Bats and Rabies
adopted October 2004

Be it resolved on this 30th day of October 2004 that researchers gathered at the 34th Annual North American Symposium on Bat Research are concerned about public misperceptions regarding undetected bites from bats, and the negative consequences for bats that are generated by those misperceptions.

Cases of rabies in humans in the United States and Canada are extremely rare. Data from the U.S. indicate that most human rabies infections occur because victims are bitten and either do not realize the risk of being bitten or trivialize the wound. No animal bite should be trivialized.

In our collective experience, bat bites cause sufficient pain to be readily detected, and if bitten by a bat, people will be aware of the bite. However, under certain circumstances (e. g., deep sleep, intoxication, illness or mental incapacity, or being a child too young to recognize or relate the history of exposure), the minor trauma and wound may not be recognized as a bat bite and could also go untreated.

We are concerned that people receiving bat bites sometimes do not seek medical attention. We are also concerned that the media and local public health agencies frequently overreact to incidental bat exposure, causing unnecessary eradication of bats or treatment of people not bitten by bats. This results in actions and public perceptions that are costly to people, detrimental to bats, and provide no additional protection against rabies.

We support:

1. education efforts regarding the human health risks associated with bat rabies that reflect the best scientific evidence available,
2. scientific and epidemiological reports and guidelines that are written to be easily understood by the average person, and
3. continuing efforts to develop a national database of rabies exposures, treatments, and outcomes.

We recognize the need for reasonable precautions against rabies. We support public education about bats and rabies that:

1. cautions to never handle bats or other wild animals;
2. warns to practice appropriate first aid measures and seek immediate medical evaluation, which may include post-exposure prophylaxis, of any actual or suspected animal bite; and
3. places the risks of human infection in perspective, without trivializing the serious nature of the disease.








APPENDIX E

Cottonwood / Sycamore Resolution from the Western Bat Working Group

Developed at the Reno, Nevada meeting
September 29, 2001

WHERE AS it has been widely demonstrated that regionally 70-98 percent of cottonwood (*Populus spp*.) and sycamore (*Platanus spp*.) galleries have been lost in western North America,

AND WHERE AS it is recognized that these ecosystems provide unique foraging and roosting habitats for bat species across western North America,

AND WHERE AS existing research and historical site records indicate a reliance on these ecosystems by the western red bat (*Lasiurus blossevillii*) in the southwestern United States,

BE IT RESOLVED that the Western Bat Working Group (WBWG) hereby supports the further research, inventory, conservation, maintenance, restoration and re-establishment of historical cottonwood and sycamore ecosystems across western North America.

FURTHERMORE this resolution will be forwarded to the national office of The Wildlife Society, Partners-In-Flight, Natural Heritage Foundation, North American Bat Conservation Partnership, and other professional and natural resource conservation organizations that have an interest in states/provinces supported by the WBWG.








APPENDIX F

Pinyon/Juniper Forest Resolution from the Nevada Bat Working Group

Developed at Reno Meeting
September 28, 2001

WHERE AS it has been widely demonstrated that the long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), and fringed myotis (*Myotis thysanodes*) roost in pinyon juniper forest habitat (Chung-MacCoubrey 1996),

AND WHERE AS the hoary bat (*Lasiurus cinereus*) has been documented roosting in Utah juniper (*Juniperus osteosperma*) (J. A. Williams, personal communication; Chung-MacCoubrey 1995) and roosting and foraging in Rocky Mountain juniper (*Juniperus scopulorum*) (P.V. Bradley, personal communication; Chung-MacCoubrey 1995),

AND WHERE AS it is recognized that the Townsend's big-eared bat (*Corynorhinus townsendii*) forages extensively in pinyon juniper habitat (P.V. Bradley, unpublished data),

AND WHERE AS it is recognized that this ecosystem provides unique foraging and roosting habitats for bat species across western North America,

BE IT RESOLVED that the Nevada Bat Working Group (NBWG) hereby supports the further research, inventory, conservation, maintenance, restoration and re-establishment of mid to late seral stage pinyon juniper forest ecosystems across Nevada.

BE IT FURTHER RESOLVED that the Nevada Bat Working Group (NBWG) hereby suggests that any treatment procedures aimed at reducing pinyon juniper habitat should:

- leave larger diameter trees (avg 46 cm dbh), especially those in a later seral stage of decay and less bark (Chung-MacCoubrey 2001).
- leave a majority of pinyon juniper habitat (suggested >70%) in tact in any watershed per historical density.
- where practical and appropriate, limit prescribed burning or vegetative alteration in pinyon-juniper or shrub steppe habitat within a 2.5 km radius of known bat roosts (Pierson et al., 1999).
- maintain a majority (suggested >70%) of the available pinyon juniper woodland canopy within 10 km of known Townsend's big-eared bat maternity colonies as critical foraging habitat.

FURTHERMORE this resolution will be forwarded to the national office of the BLM, USFS, NPS, USFWS, NDOW, BCI, The Wildlife Society, Partners-In-Flight, Natural Heritage Foundation, North American Bat Conservation Partnership, Western Bat Working Group, and other professional and natural resource conservation organizations that have a stake in the conservation of Nevada’s bats.








APPENDIX G

Nevada Bat Working Group

(Subcommittee of the Western Bat Working Group)

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APPENDIX H

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(2-year term from April 2005- March 2007)

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