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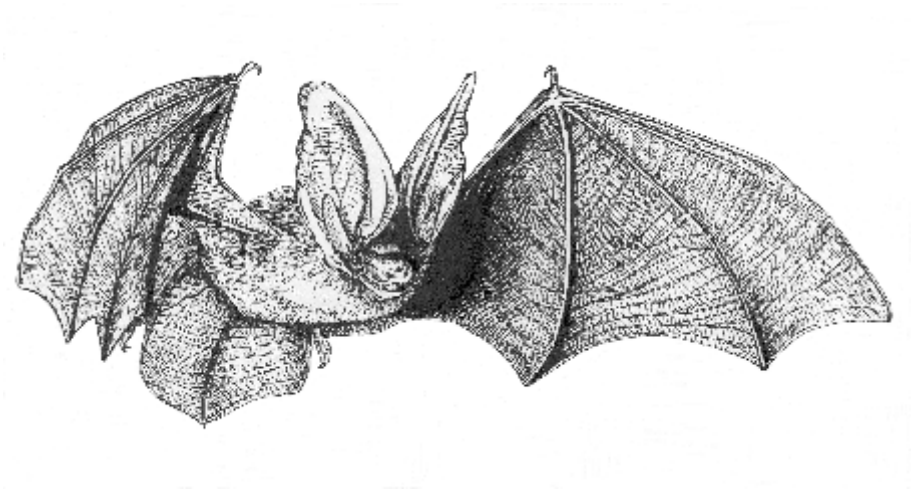
DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife Resources—Utah Natural Heritage Program

The Bats of Utah

A Literature Review

by

George V. Oliver



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Utah Division of Wildlife Resources
1594 West North Temple
Salt Lake City, Utah

John F. Kimball, Director

28 April 2000

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Introduction

This report summarizes information concerning the bat fauna of Utah. It has been 20 years since the publication of Hasenyager's *Bats of Utah* (1980), which remains one of the most useful works on the volant mammals of the state, and much on this subject has been reported during the last 2 decades. During the late 1990s several ambitious field studies of bats were conducted in Utah. Prominent among these were 2 bat inventories carried out in northern Utah in 1994 and 1995 (Lengas 1994b, Ageiss 1996) and 5 in the southern part of the state during the period 1996–1999 (Foster et al. 1997, Mollhagen and Bogan 1997, Jackson and Herder 1997, Day and Peterson 1999a, Day and Peterson 1999b). All of these surveys utilized mist-nets, involved many sampling sites, in most cases in various habitats at different elevations, and resulted in the capture and in-hand identification of large numbers of bats of many species. These studies have appreciably increased the amount of reported information that is available concerning the bats of Utah.

Available information concerning the bats of Utah from published sources and from unpublished reports such as government agency documents has been used to produce this review. While an attempt has been made to utilize as many literature sources as possible, some bibliographic materials have been very difficult to obtain, particularly some of the agency reports. Despite determined efforts, in some cases by several people, a few reports simply could not be located. Time constraints, too, affected the thoroughness of bibliographic searches. It is believed, however, that all but a few of the most important literature sources pertaining to bats in Utah have been seen.

The focus in this review is on bat information specific to Utah. Many useful summaries of the biology of the bat species that occur in Utah are available (e.g., Barbour and Davis' *Bats of America*, 1969, and the various species accounts in the *Mammalian Species* series and in Wilson and Ruff's *The Smithsonian Book of North American Mammals*, 1999), and the reader is referred to works such as these for range-wide information concerning the bat species that occur in Utah. Similarly, identification of species is not addressed here, and the reader is advised to consult works such as Barbour and Davis' *Bats of America*, 1969, Hasenyager's *Bats of Utah*, 1980, and Hall's *Mammals of North America*, 1981, all of which contain useful keys, as starting points for identification of bat species. Identification of subspecies usually involves much more effort and generally requires use of the original (i.e., type) descriptions as well as comparison of specimen material (e.g., study skins and skulls) in scientific collections in museums.

There are many aspects of bat biology that could be considered, but in this work the topics that are addressed have been limited to

- **taxonomy**, vernacular nomenclature, and variation, particularly as these have been applied in Utah or used in works that have discussed bats in this state,
- **distribution** of bats in Utah,
- **wintering habits** —i.e., hibernation, migration, and winter activity—of bats in Utah,
- relative **abundance**, by species, of bats in Utah,
- **habitat** use by bats in Utah, and
- factors pertaining to the **conservation** of bats in Utah.

As much as possible, bat information obtained outside of Utah has been intentionally ignored in the preparation of this report, since in most cases this information is readily available elsewhere. Also, the biology of some bats is highly variable across their ranges, and there may be considerable risk involved in assuming that information gathered in one region is applicable to the same species in another. For example, the Brazilian free-tailed bat forms enormous maternity colonies, consisting of up to 20 million adult females, each with young, in very large, limestone solution caves in Texas and some other states, but this species does not have comparable habits in Utah.

However, exceptions to the intended principle of exclusion of information concerning Utah bats in other parts of their ranges have been made. Taxonomy is not specific to Utah, for none of the species or subspecies of bats that inhabit this state is strictly endemic to Utah. Similarly, conservational issues in some cases are not geographic, and in other instances there are important conservational implications for Utah from work conducted in other places.

It should be noted that, even among the bat species that have been most studied in Utah, population trends in this state are unknown. Similarly, specific information concerning threats to the species of bats in Utah largely are not known. The wintering habits of many species of Utah bats also are poorly known and in some species are not known at all. Although absolute abundances of Utah bat populations are completely unknown, enough information is now available that some idea of the abundances of Utah bat species relative to each other can be inferred, bearing in mind that all methods of sampling bats are biased with regard to species.

There are several aspects of the biology of Utah bats, such as food habits and reproduction, that, despite the scientific interest in and management importance of such subjects, have not been included in this work. This is because, for most bat species that inhabit this state, little if anything has been reported concerning these aspects of their biology in Utah, and Hasenyager (1980) has reviewed much of the information pertaining to these subjects that is available.

Although a growing body of locational information for Utah bats has been collected using ultrasonic detecting devices, the identification of bats using recordings of their ultrasonic vocalizations is not yet a certain science. There are several factors that contribute to the complexity of analysis of acoustic data and that can lead to confusion regarding vocalizations and thus to misidentification. Many different bat species produce very similar vocalizations. Individual bats produce different kinds of vocalizations that serve different purposes. There may be regional differences (dialects) in the vocalizations within a bat species. Recordings that are obtained often are of fragments or incomplete vocalizations, which can be mistaken for those of other species. Reliability of analysis of acoustic data is dependent upon the completeness and quality of the reference library of verified vocalizations that the researcher uses for comparisons and identification. Reliable identification depends, too, on the researcher's skill and experience in analyzing such data. There are some bat researchers with considerable experience in the use of acoustic methods and who use such techniques to produce consistently reliable species identifications, and probably many of the identifications made by less experienced users of acoustic methods, too, are correct. However, for the purposes of this review, acoustically obtained records are viewed as suggestive but not yet, at this stage in the development of techniques for and individual experience in acoustic identification, as reliable data for species identification. In this report only minimal use has been made of acoustic data, whether those data be from recordings obtained using bat detectors or from audible vocalizations (such as are produced by at least 3 of the species that occur in Utah) heard and identified in the field by the observer. Where acoustic data are mentioned in this report, this is usually done parenthetically.

It is hoped that this review will be of use to those who manage the faunal resources of Utah as well as to those involved in scientific research on the bats of this state. Basic information concerning the life histories of many of the bat species that inhabit Utah (e.g., where they roost during the day, what they do during winter) is needed. However, the information that is critically needed to guide the management of the chiropteran resources of Utah now and in the future is that concerning population trends in the bat species of this state. The development of methods for monitoring populations of individual bat species, comparable to those that have been developed for monitoring bird populations, is essential for the effective management and conservation of bats in Utah, and bat researchers in Utah are encouraged to pursue innovative ways of obtaining such population trend data.

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Myotis lucifugus (Le Conte, 1831)
little brown myotis

Taxonomy

This species formerly was called the little brown bat by most authors (e.g., see Barbour and Davis 1969, Hasenyager 1980). Durrant (1952), however, called it the big myotis.

Only one currently recognized subspecies of this species, *M. l. carissima*, is known to occur in Utah, but one other race no longer considered valid has been reported from the state and yet a third race has been speculated to reach the state boundary.

Miller and Allen (1928) mapped their new subspecies, *M. l. phasma*, for which they had locality records from California and Colorado, as hypothetically occurring across much of Utah, from the southwest corner to the northeast corner, and commented: "Its presence in southern Utah can not be doubted, but no specimens are at hand." Hardy (1941) reported the race *M. l. phasma* from Juab County. Durrant (1952) mapped this subspecies as inhabiting the southwest quarter of the state. Hansen (1951) assigned more specimens from Juab County to this race. Shuster (1957) reexamined Hansen's specimens and referred them, as well as Hardy's specimens, to *M. l. carissima*, commenting, however, that "[i]t is probable that there is some influence from *M. l. phasma* on Utah taken specimens" of this species. Harris and Findley (1962), however, concluded that *M. l. phasma* was not a valid taxon, being a synonym of *Myotis yumanensis*.

Hall (1981) mapped all of Utah as within the range of *M. l. carissima*. However, Hall (1981) hypothetically mapped the range of *M. l. occultus* as reaching the southern boundary of the state in southeastern San Juan County and almost reaching the state line in the vicinity of Washington and Kane counties. The taxon *occultus* had been accorded specific status until Findley and Jones (1967) presented evidence that intergradation occurs between it and *M. lucifugus* and submerged *occultus* as a subspecies of *M. lucifugus*; the work of Barbour and Davis (1970) corroborated this. Most recent authors (e.g., Fenton and Barclay 1980, Hall 1981, Koopman 1993,1994) have followed this arrangement of *occultus*, but a few mammalogists continue to regard this taxon as a possibly valid species, *M. occultus*, as it had been arranged earlier. Although Hoffmeister (1986) presented evidence that *occultus* may be specifically distinct from *M. lucifugus* and tentatively considered it to be so, the recent genetic work of Valdez et al. (1999) reaffirms that it should be regarded as a subspecies of *M. lucifugus.*

Hybridization between *M. lucifugus* and *M. yumanensis* has been reported (or suspected) in some western states (Barbour and Davis 1969, Harris 1974, Parkinson 1979), including Utah. Harris (1974) reported a presumed hybrid from Uintah County by (see account of *M. yumanensis* for discussion).

Although Woodman (1993) asserted that the generic name *Myotis* is feminine and thus that the correct form of the specific epithet for the little brown bat should be *lucifuga*, Pritchard (1994) disagreed. Furthermore, Jones et al. (1997) pointed out that the International Commission on Zoological Nomenclature had officially designated *Myotis* as masculine. Thus, the name for the little brown myotis has remained *Myotis lucifugus*.

Although Pritchett (no date), in 3 places in his report on mammals of Washington County, listed captures of the little brown myotis, *M. lucifugus*, he also stated in the same report: "There is only one bat recorded [in Utah] by Hasenyager (1980) that has not been collected in Washington County. It is the little brown bat, *Myotis lucifugus*." Stock's (1965) study of the mammals of Washington County also had shown no evidence of *M. lucifugus* in that county. For these reasons, Pritchett's (no date) reported data (e.g., abundance and habitat)concerning *M. lucifugus* in Washington County have not been used here. Probably all of Pritchett's (no date) *M. lucifugus* were actually *M. yumanensis*.

Status in Utah

Distribution

The little brown myotis may occur throughout Utah, but records are lacking from large areas in the northwestern, southwestern, and south-central parts of the state and are few and scattered in east-central Utah.

Most authors have considered this species to be of statewide occurrence in Utah (e.g., Durrant 1952, Fenton and Barclay 1980, Hall 1981), although Barbour and Davis (1969) mapped its distribution as including only northern and eastern Utah. Shuster (1957) stated that it is "[k]nown from the northern two-thirds of the state."

Hasenyager (1980) had records of this species from 17 Utah counties; of his 29 mapped localities, however, 25 clustered in central and north-central Utah, with only 4 outside of this area, these 4 being widely scattered in eastern Utah.

Mollhagen and Bogan (1997) questioned whether this species occurs in the Henry Mountains and other areas in southern Utah:

> We have examined the specimen listed by Hasenyager (1980) for the Henry Mountains ... and it is not *M. lucifugus* but rather *M. ciliolabrum*. Extensive work (Bogan, unpublished data) in areas east and west of the Henry Mountains suggests that *M. lucifugus* does not occur in this part of Utah. Other nearby records of *M. lucifugus* reported from Bluff in San Juan County (to the southeast) and Bicknell and Boulder Mountain, in western Wayne County (to the northwest; Hasenyager, 1980), and preferably specimens from throughout Utah, should be re-examined to ascertain their identity.

Wintering Habits

It is not known whether the little brown myotis hibernates in Utah, perhaps even being active during mild periods, or migrates out of the state for the winter.

Twente (1960) noted that "*Myotis lucifugus* is one of the most common hibernating bats in the eastern United States and although it is present in some numbers in summer nursery colonies in Utah ..., nothing has been found which indicates the hibernating habits of this species in the western United States." His investigation of mines, caves, and buildings in Utah produced no evidence of hibernation of this species.

In other parts of its range, *M. lucifugus* hibernates, but it is also known to make short-distance migratory movements of up to 290 mi (Barbour and Davis 1969). Barbour and Davis (1969) pointed that, although the summer and winter ranges of this species in eastern North America are the same, the winter range in western North America is unknown. They also implied that migration occurs in the west, writing: "Little is known of the migratory habits of *M. lucifugus* in western North America where it is one of the most abundant bats."

Abundance

The little brown myotis is common in Utah, even though it may be rare in, or absent from, some areas.

Of 204 Utah bat specimens of 15 species examined by Hardy (1941), 6 (3%) were *M. lucifugus*; 5 other species were rarer, 8 were more common, and 1 was equal to this species in abundance.

Crane (1948) considered *M. lucifugus* to be "one of the commonest species of bats occurring in Salt Lake County."

Durrant (1952) examined 182 bat specimens of 14 species (15, if corrected for a later re-identification) from Utah; 13 (7%) of these were the little brown myotis, which ranked 6th in abundance.

Shuster (1957), examining 372 Utah specimens of bats, looked at 40 *M. lucifugus*; this species was the 4th most abundant of the 15 species of which she saw specimens, and it accounted for 11% of the total.

Jensen (1965) found the little brown myotis to be common in parts of Rich County.

Hasenyager (1980) listed records of 145 individuals of *M. lucifugus* from Utah. It was the 3rd most numerous, in his study, of the 18 species of bats known to occur in Utah and represented about 12% of all his Utah bat records.

Of 157 bats of 10 species captured in or near Dugway Proving Ground in 1995 (Ageiss 1996), none was *M. lucifugus*.

Of 220 bats of 9 species mist-netted by Lengas (1994b) in northern Utah, 47 (21%) were the little brown myotis, which was the 3rd most abundant species.

Jackson and Herder (1997) captured and identified 609 bats of 16 species in southern Utah, none of which was *M. lucifugus*. Similarly, none of the 572 bats of 15 species mist-netted by Mollhagen and Bogan (1997) in the Henry Mountains area of southern Utah was *M. lucifugus*. The little brown myotis also was not among the 640 bats of 13 kinds (13 or 14 species) mist-netted in the Grand–Staircase Escalante National Monument of southern Utah by Day and Peterson (1999a), nor was it represented among the 179 bats of 10 kinds (10 or 11 species) that they (Day and Peterson 1999b) netted in southwestern Utah.

Habitat

In Utah the little brown myotis is primarily a bat of forests of various types, often at moderately high elevation. It is also common in cities and towns in Utah, where artificially created parkland conditions resemble open forests. Day roosts reported in Utah have been in an attic and in a rock crevice. Maternity colonies in Utah have been in an attic and under a bridge. Reported Utah habitats have been highland riparian areas of willows and aspens near sagebrush and conifers and near piñon, juniper, and Douglas-fir; aspen forest; aspen–spruce forest; aspen–mixed coniferous forest; sagebrush–aspen subalpine shrubland; lodgepole pine forest; and mixed coniferous forest.

A diurnal roost of *M. lucifugus* reported in Utah was "the attic of a large farmhouse" (Hardy 1941).

Twente (1960) mentioned a little brown myotis nursery (i.e., maternity) colony in the attic of a tourist lodge in Sevier County.

Musser (1961) collected the little brown myotis in southwestern Utah at a pond in a grove of aspens and among spruces and aspens along a stream in a narrow canyon. He also found a diurnal roost of *M. lucifugus* along the shore of a lake:

> Two [little brown] bats were found in a small crevice in the volcanic rock outcrop which composes the bulk of the southwest shore .... The opening of the crevice was approximately one-half inch wide, the crevice extended to a depth of about three inches, but widened out to two inches where the bats were located. ... The bottom of the crevice was filled to a depth of approximately one inch with bat guano.

Jensen (1965) stated that the little brown myotis occurs "along the Bear River and in the open areas throughout the study area [Rich County]. In forested areas, they are largely replaced by bats of another species, *Myotis volans interior*. Of the nine specimens of *M. l. carissima* taken only one was actively feeding in a forested area while all nine specimens of *M. v. interior* were taken in forested areas." Other Utah studies have not corroborated the segregation by habitat of these 2 species hypothesized by Jensen (1965) and have found the 2 species to co-occur, often in close association, in forested areas (e.g., Musser 1961, Lengas 1994b). Lengas (1994b) found about 80–90% overlap in occurrences of the 2 species. He netted them together at 8 sites; there was only 1 site where he captured *M. lucifugus* without *M. volans* and only 2 sites where he netted *M. volans* but no *M. lucifugus.* Also, there was no apparent habitat pattern—open areas versus forest—among the 3 sites where he caught 1 species and not the other.

In Daggett County, Reynolds (1966) observed large numbers of little brown myotis entering and leaving "a fault cavern some 1,100 feet in length" in the early evening on different occasions; the bats may have been using the cave for a day roost or a night roost or both.

At the mouths of 3 caves in Cache County, Lengas (1994a) mist-netted 12, 4, and 1 little brown myotis.

Lengas (1994b) mist-netted *M. lucifugus* at 9 sites in northern Utah. These he described as a dry meadow surrounded by lodgepole pine forest (4% of captures), mixed coniferous forest (4%), sagebrush and grass meadow surrounded by mixed aspen and coniferous forest (6%), a riparian situation dominated by aspens and willows and bounded by steep canyon walls (11%), a grassy park with willows next

to mixed aspen and coniferous forest with sagebrush, mountain mahogany, and conifers nearby (2%), willows and aspens adjacent to lodgepole pine forest (53%), aspen–mixed coniferous forest (2%), mixed coniferous forest with some willows and aspens (11%), and a riparian situation with willows surrounded by sagebrush and with piñon–juniper and Douglas-fir on slopes nearby (6%).

Perkins and Peterson (1997) noted a maternity colony of *Myotis lucifugus* under a bridge in Emery County.

Foster et al. (1997)[1] netted the little brown myotis at 2 sites in southern Utah that were in subalpine low shrubland characterized by sagebrush and aspen.

Reported elevations at localities where this bat has been captured in Utah range from 4,300 (Crane 1948, Durrant 1952) to 10,000 ft (Durrant 1952, Shuster 1957).

Conservation

Fenton and Barclay (1980) have written: "Populations of *M. lucifugus* have drastically declined in numbers in many parts of its range, attributable in part to the use of pesticides ..., control measures in nursery colonies, collecting ..., and disturbance of hibernating individuals. The effect of disturbance on hibernating bats is very important, as it causes them to lose weight, thus decreasing their chances of survival."

Thomas (1995) found that visits by people to a hibernaculum of *M. lucifugus* in an abandoned mine in Québec, which involved no tactile stimulation of the bats, resulted in dramatic increases in flight activity by the bats, and that this activity peaked 1 to

[1]The published report by Foster et al. (1997) contains valuable bat data. However, these data are almost entirely contained in a table, Appendix A, of that report, and many errors (probably, at least in part, printer's errors) in the table have been found, beginning with the fact that the numbers in the table do not agree with the total stated in the text. It was hoped that the errors were few and that comparisons of the published report with a draft of the manuscript provided by the senior author of that report and with collecting permit reports submitted to the Utah Division of Wildlife Resources when the field work was done in 1995 would resolve the errors. Unfortunately, these comparisons of the 3 sources for the same data showed that there were far more errors than had been suspected, and no 2 of the 3 data sets were in perfect or even close agreement. For the benefit of future users of these data, it can be said that all bat data listed in the publication by Foster et al. (1997) for the following sites have been found to match the 2 unpublished sources for the same data and are believed to be free of errors: Yovimpa Pass, Hatch Pond, Leeds Creek, Tantalus Creek, Burnt Flat, Forshea Spring, Seven Mile Creek, Eldridge Hollow, Pahvant Road, Elk Ridge, and Warner Lake. Data for all other sites at which they reported bats show discrepancies among the 3 sources, often even as to which species were present. Throughout this report, only data that were the same in all 3 of the sources have been used, such data being mentioned in the *Habitat* sections of the species accounts. It is unfortunate that the data could not be used in the *Abundance* discussions and that many of the data that may be correct were excluded from use even in the *Habitat* reviews.

7½ hours after the human visits.

Since these bats commonly take up residence in the attics of houses, often in large colonies that produce considerable amounts of guano, they can become a nuisance. Use of chemical pesticides in such cases is not recommended and can have undesirable results (Barclay et al. 1980). Alteration of the illumination of the colony or sealing the bats out, once they have left in the evening, are preferable solutions (Fenton and Barclay 1980).

Summary

- Utah subspecies: *M. l. carissima*
- Utah distribution: possibly all, but unreported from parts of nw., sw., and s.-c.
- Utah wintering habits: unknown (hibernates and makes short-distance migratory movements elsewhere)
- Utah abundance: common (abundant in n.)
- Utah diurnal roosts: attics, rock crevices
- Utah maternity colonies: attics, bridges
- Utah habitats: highland riparian areas, aspen forests, mixed forests, coniferous forests, cities and towns
- Utah elevational range: 4,300 to 10,000 ft

Myotis yumanensis (H. Allen, 1864)
Yuma myotis

Taxonomy

The subspecies of this bat that occurs in Utah is the type (or nominate) race, *Myotis yumanensis yumanensis* (e.g., see Hall 1981).

Miller and Allen (1928), although they had no records of *M. yumanensis* from Utah and mapped the distribution of this species as hypothetically only touching the southwest corner of the state, believed that intergrades between *M. y. yumanensis*, at that time known only from south and west of Utah, and *M. y. sociabilis*, known from north of Utah, could be expected in central Utah. A record of *M. yumanensis* from Box Elder County (discussed below) is roughly midway between the known, currently accepted distributions of *M. y. yumanensis* and *M. y. sociabilis*. If this record is based on correct identification at the species level, it is suggestive of the possibility that the race *M. y. sociabilis* could be present in northwestern Utah.

Stock (1965) provided the following observations:

> Specimens I have examined from the study area [Washington County] agree colsely [*sic*] with the description of *M. y. yumanensis*, while those from Kane and Uintah counties are more pallid in adult pelage. Cranial differences are also apparent. ... These cranial and color differences are quite constant and the specimens from the Uinta Basin and the "Canyon Lands" of the Colorado River in southeastern Utah, may represent a new subspecies. I have compared only adult males from Washington County with immature males and adult females from other areas in the state and additional material is needed to clarify the relationships of these bats.

As mentioned in the account of *M. lucifugus*, which is the species that is considered to be most closely related to *M. yumanensis*, hybridization between these two bats has been reported, or suspected, in western North America (Harris and Findley 1962, Barbour and Davis 1969, Harris 1974, Parkinson 1979). There is some overlap in the ranges of these two species in Utah. In fact, large series of both species have been reported from localities only a mile apart in Uintah County (see Hasenyager 1980), and Harris (1974) stated that at 1 of these localities in Uintah County "*Myotis lucifugus* ... was found together with the Yuma myotis in a maternal roost ...." Furthermore, of 354 specimens that Harris (1974) tested by multivariate discriminant analysis using morphometric characters, 3 were intermediate between the 2 species and were judged to be hybrids; 1 of these 3 presumed hybrids was from 1½ miles west of Jensen, Uintah County. Parkinson (1979) seemed to accept Harris' (1974)

interpretation of the Jensen specimen as a hybrid, and it fit with her own "hybrid criterion". However, she was careful to point out:

> Confirmation of hybridization ... is not possible using merely statistical methods. ... The use of the term "hybrids" may not be justified, because the lack of reproductive isolation cannot be proved (for the present, at least), but it is a convenient term for morphologically intermediate individuals.

Status in Utah

Distribution

The Yuma myotis occurs throughout most of Utah, and may even range statewide, but is unknown from the northwest corner of the state and from the northernmost part of north-central Utah. Also, records are lacking from most of western Utah as well as much of central Utah. Most known Utah localities are in the southern and eastern parts of the state.

Hasenyager's (1980) mapped localities for *M. yumanensis* form a band from southwestern (Washington County) to northeastern (Uintah County) Utah, the only exception being a single locality, based on 1 individual, in north-central Utah (Bear River Refuge, Box Elder County). Hall (1981) in his shaded distribution map repeated this pattern of a southwest–northeast band of occurrence across the state, with the species being absent from the northwestern half of Utah and part of the southeastern corner (parts of San Juan and Grand counties).

An early record of this species in Utah County was discussed by Durrant (1952):

> Miller (1897:67) lists one specimen of *Myotis y. yumanensis* from Provo, Utah County, and Hardy (1941:289) cites this occurrence without comment. However, in the revision by Miller and Allen (1928:52) no specimen of this form is listed from Utah, and one specimen from Provo is listed as *Myotis lucifugus carissima.* In fact this is the only specimen of any kind of *Myotis* recorded in the revisionary paper by Miller and Allen (1928) from Provo. Probably there was only one specimen which at different times was assigned to two different species, latterly to *M. l. carissima*. The two species of *Myotis* concerned, *M. lucifugus* and *M. yumanensis*, are easily confused. It appears from the distribution of the known specimens and from the probable reassignment of the Provo specimen that *M. y. yumanensis* occurs in only the extreme southern part of the state.

Durrant et al. (1955) corrected the identification of a Utah bat specimen, assigned by Durrant (1952) to *M. lucifugus,* to *M. yumanensis*. Barbour and Davis (1969) have cautioned: "The similarity between *M. yumanensis* and *M. lucifugus* has led to many

mistaken identifications in the literature and consequent difficulty in plotting the ranges of the two species." Although Durrant (1952) likely was correct in his conclusion regarding the probable re-identification of Miller's (1897) Provo specimen, Hasenyager's (1980) record of a specimen of *M. yumanensis* from the Bear River [Migratory Bird] Refuge in eastern Box Elder County is even more surprising than a Provo record of this species. Although Hasenyager (1980) did not cite a source or provide any details for the Box Elder County record, an attempt should be made to locate the specimen, if one was indeed collected, and its identity should be carefully checked. Because of the confusing similarity of *M. yumanensis* to *M. lucifugus*, the possibility that the Box Elder County record may be based on a misidentified individual of *M. lucifugus* cannot be dismissed. *M. lucifugus* is in fact known from the Bear River [Migratory Bird] Refuge (see Hasenyager 1980), and this location is outside the generally accepted range of *M. yumanensis*. However, if *M. yumanensis* does occur in Box Elder County, the perceived gap in the distribution of this species between Idaho and southeastern Utah (e.g., see Hall 1981) may not be real, as Miller and Allen (1928) believed.

Wintering Habits

The wintering habits of the Yuma myotis in Utah are not known. It may hibernate in Utah, or it may migrate out of the state for the winter.

M. yumanensis was one of the Utah bats for which Twente (1960) found "[n]o reports ... regarding the wintering habits ... in the temperate parts of their geographical ranges." He did add, however, the "[w]here the habits of the genus *Myotis* are known in temperate regions elsewhere, it is almost invariably found to be a hibernator." His investigations shed no new light on the wintering habits of this species in Utah. Although he did not mention species, Twente did offer the following general comment concerning bats in a part of the state where *M. yumanensis* is well known:

> Bats in southwestern Utah ... do not seem to have the same problems as those in the north since hibernation may be temporary during cold periods. The bats in these regions, however, apparently feed throughout the warmer periods of the winter (personal communication from Dean Stock), thus supplementing fat lost through hibernation.

However, several studies that have reported winter activity of bats in Washington County of southwestern Utah (Stock 1965, Ruffner et al. 1979, Poché 1981), where the Yuma myotis is common (e.g., more than half of all of Hasenyager's [1980] records of individuals of this species from Utah were from Washington County), have not produced evidence of winter activity in this species.

Barbour and Davis (1969) commented that "*Myotis yumanensis* abandon the nursery colony sites in fall, but their destination and winter habits are unknown." Hoffmeister (1986), noting that there were at least 37 summer localities for this species known to him in Arizona and only 1 winter record, thought it likely that the Yuma myotis migrates out of Arizona for the winter.

Abundance

The Yuma myotis is uncommon in Utah, being fairly common in parts of southern Utah and scarce elsewhere in the state.

Of the 201 Utah bat specimens of 15 species examined by Hardy (1941), only 2 (1%) were *M. yumanensis*; only 1 bat species was rarer among the specimens that he looked at.

Although Durrant (1952) examined 182 Utah bat specimens of 14 species, none was considered to be the Yuma myotis. However, Durrant et al. (1955) reassigned a specimen that Durrant (1952) had identified as *M. lucifugus* to *M. yumanensis*. Correcting Durrant's (1952) data for this re-identification, the Yuma myotis represented 0.5% of the bats seen by Durant (1952) and was tied with 1 other species as the rarest of the 15 bats of which he examined specimens.

Shuster (1957) examined 372 bat specimens from Utah, representing 15 species, and only 3 (< 1%) of these specimens were *M. yumanensis*; it ranked 13th in abundance.

A total of 78 individuals of the Yuma myotis in Utah was reported by Hasenyager (1980), making it the 7th most abundant of the 18 bat species in his Utah study and representing about 6% of all Utah bat records known to him.

Of the 220 bats mist-netted in northern Utah by Lengas (1994b), only 1 (0.5%) was *M. yumanensis*; it was tied with 1 other of the 9 species that he caught as the rarest bat in his study.

The Yuma myotis was not represented among the 157 bats of 10 species captured in or near Dugway Proving Ground, Tooele County, in 1995 (Ageiss 1996).

M. yumanensis accounted for 30 (5%) of the 609 bats captured and identified by Jackson and Herder (1997) in southern Utah; this was the 6th most abundant of the 16 species that they caught.

Mollhagen and Bogan (1997) mist-netted 572 bats in the Henry Mountains area of

southern Utah; 13 (2%) of these were the Yuma myotis, which ranked 11th in abundance of the 15 bat species captured.

Only 3 (< 0.5%) of the 640 bats mist-netted by Day and Peterson (1999a) in the Grand Staircase–Escalante National Monument of southern Utah were the Yuma myotis; it was tied with 2 other species as the rarest among the 13 kinds (13 or 14 species) that they captured.

Day and Peterson (1999b) caught 179 bats of 10 kinds (10 or 11 species) in southwestern Utah; 13 (7%) of these were *M. yumanensis*, which was surpassed in abundance by 4 species.

Habitat

Although the Yuma myotis is generally considered to be an inhabitant of lower elevations and riparian situations, often in otherwise arid country, it is known in Utah from a variety of habitats and a wide range of elevations. Diurnal roosts in Utah have been reported in a mine and a building. A Utah maternity colony was in an attic. Habitats in which *M. yumanensis* has been captured in Utah include: lowland riparian, desert shrub, sagebrush–grass, sagebrush–grass–piñon–juniper, piñon–juniper–sagebrush, piñon–juniper, mountain brush, sagebrush–juniper–maple canyon, aspen–willow canyon, sagebrush–grass–spruce–fir, mixed forest, and wet meadow in ponderosa pine forest.

Hardy (1941) mentioned a Utah specimen of *M. yumanensis* from a mine and another "from a corner of a small room in the Gymnasium Building at Dixie College."

Ranck (1961) commented: "Records of occurrence in Utah indicate that this bat [*M. yumanensis*] is … restricted to rather arid or semiarid conditions at elevations not in excess of 5,500 feet."

Stock (1965) noted that in Utah the Yuma myotis has been found in "habitats ranging from low desert to montane valleys." He provided specific information from his Washington County study:

> The specimens from Ivins' Reservoir were taken as they foraged above the emergent vegetation along the southwest shore of the reservoir. This reservoir is situated in a desert habitat. Those from Pine Valley were taken from narrow recesses between the gable and roof supports of the Pine Valley Chapel. … Pine Valley is located in a montane valley at 6,500 feet. … Generally they were taken in arid to semiarid conditions ….

Stock (1970) added more information concerning *M. yumanensis* at Ivins' Reservoir; the elevation was 3,100 ft, and the "area [was] characterized by creosote and mesquite bushes."

Easterla (1966) found "… a breeding colony of about 125 individuals [of *M. yumanensis*] in a building attic at Kanab, Kane County, Utah, 24 July 1964. Nine were collected …. Three of the nine specimens are adult females and six are full-grown young …." Apparently this was a maternity (or nursery) colony.

Armstrong (1974) mist-netted 1 *M. yumanensis* at a spring in southeastern Utah with horsetail, cattail, bulrushes, grasses, sweet-clover, and willows and surrounded by uplands with sparse cover of ricegrass and snakeweed and open piñon–juniper woodland.

Lengas (1994b) reported the mist-net capture of a Yuma myotis in the Ashley National Forest of northern Utah in a riparian situation dominated by quaking aspen and willows and bounded by steep canyon walls.

Perkins and Peterson (1997) reported that they mist-netted the Yuma myotis in Emery County. Although they did not provide a description of the actual netting site, they did describe the general area as a canyon with sagebrush, junipers, and maples.

Mollhagen and Bogan (1997) captured this species at 8,600 ft elevation in southern Utah, but, based on their capture dates, they suggested that "perhaps this species occurs in the mountains only early in the season, after which time it likely occurs at lower elevations along permanent watercourses, as is typical for this species."

Jackson and Herder (1997) captured *M. yumanensis* at 7 locations in southern Utah mostly in riparian habitats (83%) but also in desert shrub (13%) and ponderosa pine forest (3%). (They also reported that they detected this species acoustically at 9 other localities, all in a similar range of habitats and elevations.)

Day and Peterson (1999a) captured this species at 3 locations in southern Utah, the habitats being described as a riparian situation (33%), piñon–juniper–sagebrush (33%), and mountain brush (33%). Day and Peterson (1999b) reported this species from 5 localities in southwestern Utah, the habitats being sagebrush–grass (8%), sagebrush–grass–piñon–juniper (15%), sagebrush–grass–spruce–fir (23%), mixed forest (38%), and a wet meadow in ponderosa pine forest (15%).

The range of reported elevations of capture of *M. yumanensis* in Utah is 2,800 ft (Jackson and Herder 1997) to 10,098 ft (Day and Peterson 1999b). (Jackson and Herder [1997] also reported acoustic detection of the Yuma myotis in Utah at 2,400 ft elevation.)

Conservation

Working in California, Dalquest (1947) reported that nursery colonies from which he collected specimens of this species were either abandoned or reduced in numbers when he returned to them.

Summary

- Utah subspecies: *M. y. yumanensis*
- Utah distribution: all except the nw. corner and extreme n.-c.; possibly statewide; few records in w. and c.
- Utah wintering habits: unknown
- Utah abundance: uncommon (fairly common in some places in s., rare elsewhere)
- Utah diurnal roosts: mines, buildings
- Utah maternity colonies: attics
- Utah habitats: lowland riparian and desert shrub to montane forest
- Utah elevational range: #2,800 to 10,098 ft

Myotis evotis (H. Allen, 1864)
long-eared myotis

Taxonomy

Manning (1993) studied morphometric variation of the long-eared myotis throughout its range. He resurrected the name *chrysonotus*, which had long been considered a synonym of *M. e. evotis* (e.g., Durrant 1952, Shuster 1957, Hall 1981, Manning and Jones 1989), as a valid subspecies and indicated that this race, *M. e. chrysonotus*, occurs throughout Utah. Earlier authors (e.g., Hardy 1941) had also assigned Utah specimens of the long-eared myotis to the subspecies *M. e. chrysonotus*.

Hoffmeister and Krutzsch (1955) described the subspecies *Myotis evotis apache* from southern Arizona and noted that the 6 specimens of *M. evotis* that they examined from Utah were, in 2 characteristics—color of wing and other membranes and color of the basal band of the fur—"somewhat similar to *M. e. apache.*" Hoffmeister and Krutzsch (1955), however, assigned the Utah specimens to *M. e. evotis*. The race *apache* has subsequently been shown to belong to another species, *Myotis auriculus*, which does not, so far as is known, occur in Utah.

Status in Utah

Distribution

The long-eared myotis occurs throughout Utah.

Durrant (1952) mapped *M. evotis* as occurring statewide and believed that, despite the few Utah localities known to him, it "occurs throughout Utah in appropriate habitat." Shuster (1957) and Hasenyager (1980) also considered the long-eared myotis to range throughout Utah. Barbour and Davis (1969) mapped *M. evotis* as occurring throughout the state except for the extreme southwest corner. Hall (1981) mapped the species as occurring statewide, with the limit of its range falling just southwest of the southwest corner of the state. Manning and Jones (1989) mapped this bat's distribution as including all but southwestern Utah (i.e., southern Washington County and southwestern Kane County).

It is interesting that Barbour and Davis (1969) excluded extreme southwestern Washington County from the range of this species, and it is even more surprising that Manning and Jones (1989) excluded an even larger area that includes at least 2 well-

known, published localities for this species: St. George (Hardy 1941, Durrant 1952) and Zion National Park (Durrant 1952).

Wintering Habits

The wintering habits of the long-eared myotis are unknown in Utah and throughout its entire range.

This was one of the Utah bats for which Twente (1960) found no reports concerning wintering habits in the temperate parts of their ranges. He noted that members of the genus *Myotis* for which the winter habits are known in temperate areas outside of Utah are invariably hibernators, but he pointed out that "[s]ome species which presumably hibernate [including *M. evotis*] have been found to inhabit buildings in Utah during the summer but none have been found in buildings or elsewhere reported from Utah in winter." His investigations of caves, mines, and buildings in Utah failed to reveal the winter habits of this bat.

Stock (1965), noting that the long-eared myotis prefers higher elevations, thought that a specimen reported by Hardy (1941) from St. George "may have been a migrant since this locality is in a low desert situation." This specimen was collected in September (Hardy 1941).

Barbour and Davis (1969) commented: "Although *M. evotis* is widespread and not uncommon, very little is known of its habits." Manning and Jones (1989) speculated concerning this species: "These bats probably migrate short distances between summer haunts and winter retreats, although the winter range of *M. evotis* is unreported. Nothing is known about hibernacula ..., but this species probably seeks winter retreats primarily in caves and abandoned mines." However, many caves and abandoned mines have been surveyed for hibernating bats in Utah, and *M. evotis* has not been found. If the long-eared myotis does hibernate in Utah in caves and mines, it must be using extremely well concealed situations, such as deep crevices, in which it goes undetected.

Abundance

The long-eared myotis is common in Utah. Although earlier work seemed to indicate that this bat was rare in Utah, the Utah bat studies of the 1990s showed that it is more common than formerly believed. The change in apparent abundance is probably a result of the change in methods used to sample bats rather than an increase in Utah populations of *M. evotis*.

Hardy (1941) examined 204 bat specimens of 15 species from Utah, of which only 3 (< 1.5%) individuals were *M. evotis*; only 3 other species were rarer.

Of the 182 Utah bat specimens that Durrant examined, only 3 (< 2%) were *M. evotis*, and only 1 bat species among the 14 (2 of 15, if corrected for a later re-identification) of which Durrant saw specimens was less numerous. Durrant (1952) mentioned that this species "is apparently nowhere common, and usually is found singly."

Shuster (1957) reported 20 long-eared bats among the 372 Utah bat specimens that she examined; *M. evotis* represented 5% of the specimens and was of medium abundance (7th of 15 species).

Hasenyager (1980) reported more than 50 individuals of *M. evotis* from Utah, making it the 9th most common of the 18 Utah bat species in his study; *M. evotis* represented 4% of all bats in his report.

Of 220 bats netted by Lengas (1994b) in northern Utah, 37 (17%) were the long-eared myotis, which was the 4th most common of the 9 species that he captured.

Among the 157 bats of 10 species captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), only 1 (0.6%) was *M. evotis*, which tied with 3 other species as the rarest bats captured in the study.

Of the 609 bats captured and identified in southern Utah by Jackson and Herder (1997), 33 (5%) were *M. evotis*, and it was the 4th most abundant bat.

In the Henry Mountains of southern Utah, Mollhagen and Bogan (1997) mist-netted 75 individuals of *M. evotis*, which was the 2nd most abundant of the 15 bat species that they captured and accounted for 13% of all captures.

Day and Peterson (1999a) found *M. evotis* to be the 6th most common of the 13 kinds (13 or 14 species) of bats that they captured in the Grand Staircase–Escalante National Monument of south-central Utah; 43 (7%) of the 640 bats that they mist-netted were this species.

Of 10 kinds of bats (10 or 11 species) captured by Day and Peterson (1999b) in southwestern Utah, *M. evotis* was tied with one other species as the 2nd most common bat and accounted for 22 (12%) of the 179 bats that they caught.

Habitat

The long-eared myotis utilizes a wide variety of habitats in Utah. Diurnal roosts may

be in buildings. Maternity roosts apparently have not been documented in Utah. Habitats reported for this bat in Utah include: lowland riparian, sagebrush–grass, sagebrush–rabbitbrush, juniper–sagebrush, sagebrush–greasewood near piñon–juniper, piñon–juniper–sagebrush, juniper, piñon–juniper, submontane tall shrubland (tamarisk–willow–piñon), riparian with willow and sagebrush near piñon–juniper, montane grassland (grass–sagebrush and grass–aspen), subalpine low shrubland (sagebrush–aspen), montane forest and woodland (grass–spruce–aspen), sagebrush–grass meadow in mixed forest, grassy park with willow near mixed forest, wet meadow in mixed forest, mixed forest, mixed coniferous forest, and ponderosa pine forest.

Hardy (1941) reported that one of the first few specimens found in Utah was taken from a tent in a campground. Twente (1960) mentioned that *M. evotis* has been found to inhabit buildings in Utah in summer.

Hansen (1951) reported collecting a long-eared myotis in central Utah in a grove of narrow-leafed cottonwoods.

Easterla (1965) reported taking this species in southern Utah in treeless, rolling habitat dominated by sagebrush and rabbitbrush but with ponderosa pine forest a few miles away.

Lengas (1994a) mist-netted 1, 1, and 4 *M. evotis* at the mouths of 3 caves in Cache County and found 1 bat of this species roosting in 1 of these caves.

Lengas (1994b) reported the habitats at 6 sites in northern Utah where he mist-netted the long-eared myotis: a sagebrush–grass meadow in mixed forest (5%), a grassy park with willows near mixed forest (8%), piñon–juniper–sagebrush (8%), mixed coniferous forest (3%), sagebrush–greasewood with piñon–juniper nearby (73%), and a riparian area with willows and sagebrush and, nearby, piñon–juniper (3%).

Among the habitats reported by Foster et al. (1997) where they captured this bat in southern Utah were: submontane tall shrubland (tamarisk–willow–piñon), montane grassland (grass–sagebrush and grass–aspen), subalpine low shrubland (sagebrush–aspen), and montane forest and woodland (grass–spruce–aspen).

In southern Utah Jackson and Herder (1997) captured *M. evotis* in riparian (9%), juniper–sagebrush (15%), juniper (6%), piñon–juniper (48%), and wet meadow in mixed forest (3%); they also reported capture of the long-eared myotis at 2 other sites for which they did not provide indication of habitat (18%).

In the Grand Staircase–Escalante National Monument of southern Utah, Day and

Peterson (1999a) mist-netted *M. evotis* in riparian (5%), piñon–juniper (28%), and piñon–juniper–sagebrush (67%) habitats.

Day and Peterson (1999b) reported capturing *M. evotis* in southwestern Utah in sagebrush–grass (5%), mixed forest (50%), and ponderosa pine forest (45%) communities; 3 of their 4 capture sites were caves.

Reported elevations of Utah sites where this species has been found range from 4,700 ft (Mollhagen and Bogan 1997) to 9,500 ft (Shuster 1957). Although no elevation was reported for the specimen from St. George (Hardy 1941), the town is situated at about 2,880 ft, a surprisingly low elevation for this species in Utah.

Conservation

Timber harvest, alteration of riparian habitats, and clearing of piñon–juniper woodland all could negatively impact the long-eared myotis in Utah.

In their study of organochlorine residues in bats following spraying of DDT to control the Douglas-fir tussock moth in forests in northeastern Oregon, Henny et al. (1992) found that *M. evotis* was the least affected of the 5 bat species that were present, there being no significant change in pesticide levels in these bats following the spraying.

Summary

- Utah subspecies: *M. e. chrysonotus*
- Utah distribution: all
- Utah wintering habits: unknown
- Utah abundance: common
- Utah diurnal roosts: buildings, caves
- Utah maternity roosts: unknown
- Utah habitats: lowland riparian and sagebrush to montane forest
- Utah elevational range: 4,700 to 9,500 ft (also 2,800 ft, perhaps aberrant)

Myotis thysanodes Miller, 1897
fringed myotis

Taxonomy

The subspecies of this bat that occurs in Utah is the nominate race, *Myotis thysanodes thysanodes* (see Musser and Durrant 1960, O'Farrell and Studier 1980, Hall 1981).

Durrant (1952), discussing the absence (at that time) of specimens from Utah, called this species the fringe-tailed myotis.

Status in Utah

Distribution

The fringed myotis may occur throughout Utah; however, except for southern, southeastern, and extreme north-central Utah, records of this species are few and scattered. *M. thysanodes* is not known from most of western Utah and is completely unknown from northwestern Utah. There are also very few records of the fringed myotis from central and northeastern Utah.

Although Miller and Allen (1928) had no records of this species from Utah, they hypothetically mapped its occurrence in all of Utah except for the northeastern corner (Daggett and part of Uintah counties) and only barely including Rich County, the edge of the distributional limit touching the northeast corner of Rich County. Somewhat similarly, O'Farrell and Studier (1980) mapped the range of this species as including all of Utah, though just barely so, with the edge of the hypothetical range touching the northeast corner of Rich County and passing also a short distance north and east of the northeast corner of Daggett County.

Hall (1981), however, mapped the distribution of *M. thysanodes* more conservatively to include approximately the southern and western two-thirds of Utah, the area south of a line running from the northwestern corner of the state (Box Elder County) to the middle of the Utah–Colorado border (Grand County).

Earlier, Barbour and Davis (1969) had mapped the range of *M. thysanodes* even more conservatively as disjunct populations scattered throughout western America and including only the southeastern one-third of Utah—from the southwestern corner (Washington County) to the middle of the Utah–Colorado boundary (Grand County)

south and east. Very nearly the same Utah distribution was found by Hasenyager (1980), who mentioned that "only specimens from southern and east-central Utah have been recorded in the literature."

Wintering Habits

The wintering habits of the fringed myotis are unknown in Utah and, apparently, throughout the range of this species.

Twente (1960), considering the winter habits of bats in Utah, noted that he had found no reports of the wintering habits of *M. thysanodes* but also commented that members of the genus *Myotis*, where their habits are known in temperate regions outside of Utah, are almost invariably hibernators. Unfortunately his study did not reveal the winter habits of this species in Utah. Barbour and Davis (1969) wrote: "As with many other western species of bats nothing is known of the winter habits of *M. thysanodes*. The maternity clusters apparently break up in the fall but their movements are unknown. This is a species that would well repay careful study."

O'Farrell and Studier (1980) stated: "Fringed myotis are known to migrate, although little is known about the magnitude of movements or destination of all migrators. ... Studier and O'Farrell (1972) speculated ... that fall migrations were of short distances to lower elevations or more southern areas where the bats could be periodically active in winter."

Abundance

Overall, the fringed myotis is uncommon in Utah. However, its abundance varies locally—it is the most abundant bat in some places in Utah and apparently is absent from other locations that provide seemingly suitable habitat.

M. thysanodes was first collected in Utah in 1940, but this was not reported in the literature until1955 ,when Krutzsch and Heppenstall (1955) published the record of 2 specimens taken in Grand County.

Hasenyager (1980) found records of only 21 individuals of *M. thysanodes* in Utah; this species represented less than 2% of all the bats recorded by Hasenyager from the state, and it ranked 14th in abundance among the 18 bat species documented from Utah in his study.

None of the 220 bats of 9 species mist-netted by Lengas (1994b) in the Ashley National Forest of northern Utah was the fringed myotis.

Of 157 bats of 10 species captured in and near Dugway Proving Ground in Tooele County (Ageiss 1996), 1 (0.6%) was *M. thysanodes*; along with 3 other species with which it tied, it was the rarest bat.

Of 609 bats captured and identified by Jackson and Herder (1997) in southern Utah, 25 (4%) were *M. thysanodes*, which was 10th in abundance of the 16 species that they caught.

Mollhagen and Bogan (1997) found this species to be "moderately common" in the Henry Mountains, where, of 572 bats mist-netted, they captured 34 (6%) *M. thysanodes*; of the 15 bat species that they found in the Henry Mountains, this was the 8th most abundant.

Of 640 bats netted in the Grand Staircase–Escalante National Monument of southern Utah by Day and Peterson (1999a), 41 (6%) were *M. thysanodes*; it was the 7th most common bat of the 13 kinds (13 or 14 species) of bats that they captured.

In Day and Peterson's (1999b) bat survey in southwestern Utah, *M. thysanodes* was the most abundant of the 10 kinds (10 or 11 species) of bats that they caught; they captured 71 fringed myotis, 40% of the 179 bats examined in their study.

These recent Utah studies appear to confirm what Barbour and Davis (1969) had earlier predicted: "It [*M. thysanodes*] is probably much more common than the records indicate."

Habitat

The fringed myotis has been found in Utah in a moderately wide range of habitats: lowland riparian, desert shrub, juniper–sagebrush, sagebrush–rabbitbrush, piñon–juniper–sagebrush, piñon–juniper, mountain meadow, ponderosa pine forest, and montane forest and woodland (Douglas-fir–aspen). Maternity roosts in Utah have been reported in an attic of a building and (possibly) a cave, and the same cave has been speculated possibly to be a day or night roost.

Musser and Durrant (1960) reported "a colony estimated to contain approximately 35 individuals found roosting in the dark attic of an old pioneer church house" in southwestern Utah. They asserted: "The location of the colony referred to ... substantiates the idea that these bats prefer old buildings as dwelling places. This is especially apparent when considering the number of caves, particularly in Utah, which

have been collected and yielded no specimens of the fringed myotis. Indeed, throughout the entire range of *M. thysanodes*, most of the known specimens have been obtained from abandoned buildings ....” Stock (1965), too, reported a visit to this colony on the first of the 3 dates reported by Musser and Durrant(1960). Stock (1965) wrote: “This colony consisted of nearly 50 individuals [of *M. thysanodes*] ... and appeared to be a nursery colony of females and young.” Although Musser and Durrant (1960) made no mention of reproduction or the reproductive condition of the specimens that they collected, they did report that they took 10 females and 1 male, which suggests that Stock (1965) was correct about its being a maternity colony. However, since Musser and Durrant (1960) mentioned the 3 collectors who took specimens from the colony and Stock’s name was not among them, it is possible that Stock did not see the colony himself and was only reporting what he had been heard from those who did, even though he did not indicate any personal communications in his discussion of this colony and did not cite Musser and Durrant (1960).

Easterla (1965) collected the fringed myotis in a “treeless and rolling” area in southern Utah “with sagebrush (*Artemisia* sp.) and rabbitbrush (*Chrysothamnus nausiosus*) forming the dominant vegetation. ... [Y]ellow pine, *Pinus ponderosa*, [was] the dominant tree in mountainous areas about 3–4 miles from the netting site.”

Easterla (1966) mist-netted *M. thysanodes* at the entrances of 2 caves in southwestern Utah (Garfield and Kane counties). At 1 of these caves, Mammoth Cave (Garfield County), he reported what he called a “breeding group”:

> Full-grown young and adults of both sexes [of *M. thysanodes*] were collected. ... Despite thorough searching within this lava tube cave, no bats were located during the day. Apparently *Myotis thysanodes* hides in cracks or crevices during the daytime and can easily be overlooked when searching for bats in caves in the usual manner.

One of the habitats where Foster et al. (1997) reported that they mist-netted *M. thysanodes* in southern Utah was in montane forest and woodland characterized by Douglas-fir (*Pseudotsuga menziesii*) and quaking aspen (*Populus tremuloides*).

Jackson and Herder (1997) caught this bat in southern Utah in 4 habitats: riparian (20%), desert shrub (64%), juniper–sagebrush (8%), and piñon–juniper (8%).

Day and Peterson (1999a) netted *M. thysanodes* in south-central Utah in 5 habitats: riparian (7%), desert shrub (56%), piñon–juniper–sagebrush (27%), piñon–juniper (7%), and mountain meadow (2%).

Day and Peterson (1999b) found this bat at 1 of 15 sites that they surveyed for bats in southwestern Utah; the inhabited site was a cave in ponderosa pine forest—Mammoth Cave, where Easterla (1966) had reported this species (see above).

They speculated that this cave "may provide night, day and maternity roosting habitat" for *M. thysanodes*, which they considered to be "a cave obligate", in disagreement with Musser and Durrant (1960) (see above).

Extremes of reported elevations of the capture of the fringed myotis in Utah are 2,400 ft (Jackson and Herder 1997) and 8,900 ft (Mollhagen and Bogan 1997).

Conservation

O'Farrell and Studier (1980) commented, concerning *M. thysanodes*: "This species seems easily disturbed by human presence. ... [P]rior to parturition females become even more secretive and are virtually impossible to approach." This suggests that disturbance of maternity colonies may be a threat to this species.

Summary

- Utah subspecies: *M. t. thysanodes*
- Utah distribution: possibly all, but no records from nw. and most of w., few and scattered in c. and ne.
- Utah wintering habits: unknown
- Utah abundance: uncommon
- Utah habitats: many, from lowland riparian and desert shrub to montane forest and meadows
- Utah maternity colonies: attics of abandoned buildings, possibly caves
- Utah elevational range: 2,400 to 8,900 ft

Myotis volans (H. Allen, 1866)
long-legged myotis

Taxonomy

The race of the long-legged myotis that occurs in Utah is *Myotis volans interior* (see Warner and Czaplewski 1984, Hall 1981, Koopman 1994).

Durrant (1952) and others (Berryman 1948, Hansen 1951), discussing this species in Utah, called it the hairy-winged myotis.

Bogan (1978), concerning this species, noted that "the nominate form [*M. v. volans*] is markedly different from the other subspecies, both morphologically and ecologically" and that it is "apparently disjunct", being found in Baja California whereas the other 3 subspecies assigned to *M. volans* occur only on the mainland of North America. He examined morphological characters of more than 400 specimens, representing all 4 of the nominal races of *M. volans*, and conducted univariate and multivariate analyses of these data. He found that, "[m]orphologically, *M. v. volans* is significantly smaller, markedly different in color, but similar in general shape characters to other *M. volans*." He also stated: "Multivariate analyses indicate that *M. v. volans* is no closer phenetically to other *volans* than are several other species of New World *Myotis*. Regardless of what taxonomic decisions are made in light of this study, the *volans* in Baja California has been isolated from other populations of *volans* for a considerable period of time." Recently Bogan (1999) again commented, concerning bats nominally assigned to *M. volans*: "[T]here is the strong possibility (Bogan, unpublished data) that bats from most or all of Baja California represent a distinct species, to which the name *volans* would apply; bats occurring elsewhere in North America would then be known as *M. longicrus* True." If further work supports Bogan's (1978) findings, bats that have been known as *M. volans* in Utah may come to be known as *M. longicrus*, as Bogan (1999) has pointed out; however, since True did not name *longicrus* as a member of the genus *Myotis*, the name would be *Myotis longicrus* (True) if the author of the name were mentioned.

Status in Utah

Distribution

The long-legged myotis occurs throughout Utah.

Although Miller and Allen (1928) had no records of *M. volans* from Utah, they mapped its distribution as including all of this state. Barbour and Davis (1969), however, in their map for this species, indicated its absence from the southwestern corner of Utah, and they commented that "[i]t seems to be absent from the lowland deserts of the Southwest." Although there may be habitats in Utah unsuitable for *M. volans*, including some of the Utah portion of the Mojave Desert, other authors (e.g., Durrant 1952, Shuster 1957, Hall 1981, and Warner and Czaplewski 1984) have considered it to occur throughout the state, and records of this species from Washington County (e.g., Stock 1965, 1970) demonstrate its presence, in proper habitat, in the southwestern corner of Utah.

Hasenyager (1980) compiled records of *M. volans* from 20 Utah counties, and his distribution map for this species shows that it is generally distributed throughout the state.

Wintering Habits

The wintering habits of the long-legged myotis in Utah are not known; however, there have been reports suggestive of possible migration and even hibernation by this species in Utah.

Twente (1960) noted that there had been no reports of the wintering habits of *M. volans* in the temperate parts of its range but that members of the genus *Myotis* whose winter habits are known invariably are hibernators in temperate regions.

Hasenyager (1980) stated: "Twente (1960) collected a hibernating female [*M. volans*] in Logan Cave [Cache County, Utah] on 10 February 1957. This indicates the species [*M. volans*] does spend the winter in Utah, even though suitable hibernacula are few." The date is consistent with the referenced study, "which was initiated in January 1957" (Twente 1960), and Twente did investigate Logan Cave on multiple occasions in January and February of more than one year and found bats of 3 species there, including a species of *Myotis* (see Twente 1960). However, the hibernation record of *M. volans* attributed to Twente (1960) by Hasenyager (1980) does not appear in the cited work. There is no mention of a female of any species in Logan Cave in the article by Twente (1960), nor does the date 10 February 1957 appear anywhere in that publication. Although it would appear that Hasenyager (1980) was entirely mistaken about the hibernation record, there is a specimen identified as *M. volans*, number 27401 in the mammal collection of the Utah Museum of Natural History at the University of Utah, bearing data on the specimen tag that match the information stated by Hasenyager (1980) (i.e., collected by J. W. Twente, 10 February 1957, from Logan Cave). Eric A. Rickart has looked at this specimen and stated (pers. comm.):

> Unfortunately, the specimen is skin only. It appears to be *Myotis volans*, and was not annotated by the last expert to go over the *Myotis* in our collection (Mike Bogan from University of New Mexico).

Thus, if the specimen has been correctly identified, it appears that Hasenyager (1980) was correct about this hibernation record for *M. volans* in Utah, even though it did not appear in the publication that Hasenyager (1980) cited as its source. The most puzzling aspect of this record, however, is that, despite its having been obtained by Twente as part of his study and despite the considerable scientific interest that such a record would hold, seemingly being the first record of hibernation in this species anywhere, Twente (1960) did not mention it in his publication but instead implied that the wintering habits of *M. volans* simply were unknown.

Barbour and Davis (1969) wrote of *M. volans*: "Winter range unknown; there is a March record from a cave in Washington. Apparently a few hibernate in Jewel Cave, South Dakota (Jones and Genoways, 1967...)." Studies published since Barbour and Davis' (1969) work have confirmed that this species does hibernate in South Dakota (Martin and Hawks 1972) and in Alberta (Showalter 1980). Barbour and Davis (1969) also commented, concerning this species: "Apparently the adults and young leave the maternity colonies in the fall, but nothing is known of their subsequent movements."

Stock (1965, 1970) thought that an individual of this species that he collected on 1 September in southwestern Utah "may have been in migration" because it was "well out of" (Stock 1965) and "well below" (Stock 1970) "the preferred habitat of this species." However, recent work demonstrates that neither the elevation nor the habitat of Stock's specimen is as aberrant for *M. volans* in Utah as Stock (1965, 1970) believed (see discussion below under *Habitat*). Thus it is questionable whether Stock's record actually is suggestive of migration.

Sherwin (no date, a) reported the use of abandoned mines as roosts by the long-legged myotis in north-central Utah. One of these mines was "used heavily during the fall by *Myotis volans*", and he referred to this as "heavy migration use". Another mine he said was "utilized in the winter season by *Myotis volans*". Although he did not mention whether the bats were hibernating, this seems to have been the implication.
More information concerning these fall and winter roosts of *M. volans* would be desirable since they suggest both migration and hibernation in *M. volans* in Utah.

Abundance

The long-legged myotis is abundant in Utah. Barbour and Davis (1969), writing of *M. volans*, commented: "This is the common *Myotis* of the western United States and

over large areas is probably the most abundant species." Early studies of bats in Utah, however, failed to reveal how common it is in this state.

Only 2 (1%) of the 204 bat specimens from Utah examined by Hardy (1941) were *M. volans*, and only 1 of the 15 bat species of which he saw Utah specimens was rarer.

Durrant (1952) examined 8 Utah specimens of the long-legged myotis; it was the 7th most numerous bat of the 14 species (15, if corrected for a later re-identification) for which he had Utah specimens and accounted for 4% of the 182 bat specimens available to him.

M. volans represented 30 (8%) of the 372 bat specimens from Utah examined by Shuster (1957) and was the 7th most common of the 15 species that she knew from specimens.

Hasenyager (1980) compiled records of 89 long-legged myotis from Utah; this bat accounted for 7% of all the Utah bats in his study and was the 6th most numerous of the 18 Utah species.

Hallows (1982) regarded the long-legged myotis as 1 of the 2 most common bats of Bryce Canyon National park.

Among 220 bats mist-netted in northern Utah by Lengas (1994b), 60 (27%) were *M. volans*; this was the most abundant of 9 bat species captured in his study.

Of 157 bats captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), 6 (4%) were *M. volans*; it was tied with 1 other species,

Of 609 bats captured and identified in southern Utah by Jackson and Herder (1997), 32 (5%) were the long-legged myotis; it was the 5th most common of the 16 bat species that they caught.

Mollhagen and Bogan (1997) reported: "This species [*M. volans*] is … abundant in the Henry Mountains region." Of 572 bats that they mist-netted, 71 (12%) were *M. volans*; only 2 of the 15 species of bats that they caught were more abundant.

Day and Peterson (1999a) mist-netted 57 long-legged myotis in their inventory of bats of the Grand Staircase–Escalante National Monument in south-central Utah; this was 9% of the 640 bats captured in their sampling. *M. volans* was the 5th most common species among the 13 kinds (13 or 14 species) that they caught.

Of the 179 bats captured by Day and Peterson (1999b) in their bat survey in

southwestern Utah, 11 individuals (6%) were *M. volans*; it ranked 7th in abundance among the 10 kinds (10 or 11 species) of bats that they captured.

Habitat

The long-legged myotis occurs in Utah in a variety of habitats including: lowland riparian, desert shrub, juniper–sagebrush, juniper, piñon–juniper–sagebrush, piñon–juniper, sagebrush–grass, mountain meadow, ponderosa pine forest, aspen forest, sagebrush–rabbitbrush, highland riparian, mixed coniferous forest, montane grassland (grass–aspen), montane forest and woodland (grass, Douglas-fir, spruce, aspen), subalpine low shrubland (sagebrush, willow, aspen), sagebrush–spruce–fir–lodgepole pine, aspen–coniferous forest, lodgepole pine forest. Roosts have been found in abandoned mines in Utah.

Berryman (1948) reported the long-legged myotis in northwestern Utah in an aspen stand near a stream. Hansen (1951) also mentioned collecting *M. volans* among aspens along a stream in the Deep Creek Mountains. Jensen (1965) reported that all 9 specimens of *M. volans* known to him from Rich County were from forested areas; he also thought that competition with *Myotis lucifugus*, which he found in more open habitats in Rich County, restricted *M. volans* to the forests, but other Utah studies have shown the 2 species to occur together (see account of *M. lucifugus*).

Reynolds (1966), working in northeastern Utah, considered *M. volans* to "have a wide ecological tolerance" and reported: "They [*M. volans*] were observed and recovered in various habitats from the open sagebrush country … to the montane forests of alpine fir (*Abies lasiocarpa*), and Engelmann spruce (*Picea engelmanni*) …. Specimens were obtained along water courses, over ponds, in narrow canyons, and from clearings in the forests of Lodgepole pine." Dearden (1967) considered the long-legged myotis to occur throughout Summit County "but generally [in] mountainous areas above 5,000 feet."

Easterla (1965) collected *M. volans* in southern Utah in a treeless, rolling area of sagebrush and rabbitbrush; ponderosa pine forest was present in mountainous terrain 3–4 mi away.

Stock (1965) reported a specimen of *M. volans* that was collected in southwestern Utah near a reservoir "as it flew … over stands of tamarix. … [T]his site is situated in a low desert, characterized by creosote, sand sagebrush, and desert willow, well out of the preferred habitat of this species." He also commented: "Collection records of these bats [*M. volans*] from Utah indicate that they prefer open coniferous forests and montane meadows above 5,000 feet. In Utah, they are frequently the most common myotis around bodies of water at higher elevations." Stock (1970) reiterated this,

writing: "[T]he collection site is well below the montane environments preferred by this species [*M. volans*] in Utah." Recent bat surveys in southern Utah, however, have shown that *M. volans* regularly occurs in desert shrub communities (see discussions below of the work of Jackson and Herder 1997 and Day and Peterson 1999a) and at elevations almost as low —3,880 ft (Jackson and Herder 1997)— as that reported by Stock (1965)—3,150 ft.

Musser (1961) collected the long-legged myotis in southwestern Utah in a steep canyon among spruces and aspens.

Lengas (1994a) mist-netted 3 and 2 *M. volans* at the mouths of 2 caves in Cache County.

Lengas (1994b) caught the long-legged myotis in northern Utah in a variety of forest situations: sagebrush in piñon–juniper (17%), mixed coniferous forest (8%), dry meadow in lodgepole pine forest (3%), sagebrush–grass meadow in mixed aspen–coniferous forest (7%), riparian aspen–willow in a steep canyon (10%), riparian willow in mixed forest (12%), willow–aspen in lodgepole pine forest (3%), grass–willow park near mixed forest and sagebrush–mountain mahogany (40%).

Toone (1994) mist-netted *M. volans* in southeastern Utah at a pond surrounded by meadow and mixed forest.

Sherwin (no date, a) reported the use of 3 abandoned mines as roosts by the long-legged myotis in north-central Utah. One of these mines was used during the summer and had contained an estimated 15 or more *M. volans*.

Foster et al. (1997) captured *M. volans* in southern Utah in montane grassland (grass–aspen), montane forest and woodland (Douglas-fir–aspen and grass–spruce–aspen), and subalpine low shrubland (sagebrush–aspen and sagebrush–willow–aspen).

Jackson and Herder (1997) captured the long-legged myotis in southern Utah in riparian (25%), desert shrub (3%), juniper (16%), juniper–sagebrush (19%), and piñon–juniper habitats (38%). (They also reported that they detected this species acoustically, using ultrasonic detection devices, in yet other habitats—dry meadow and ponderosa pine forest and at 1 site that they indicated as ponderosa pine forest but is actually spruce–fir forest.)

Seasonal trends in the elevations at which Mollhagen and Bogan (1997) netted *M. volans* in the Henry Mountains, from lower in May to higher in June–August,

suggested to them that "this species [*M. volans*] (perhaps chiefly females, to give birth and raise young) migrates to upper elevations as weather warms in summer."

Day and Peterson (1999a) captured *M. volans* in south-central Utah in riparian (7%), desert shrub (5%), piñon–juniper–sagebrush (49%), piñon–juniper (37%), and mountain meadow situations (2%). Day and Peterson (1999b), working in southwestern Utah, caught this species in riparian (55%), sagebrush–grass (9%), and ponderosa pine forest habitats (36%).

Extremes of reported elevations at which *M. volans* has been taken in Utah are 3,150 ft (Stock 1965) to 10,100 ft (Mollhagen and Bogan 1997). Reynolds (1966) mentioned the presence of the long-legged myotis at 10,500 ft elevation in northeastern Utah, but this apparently was an observation, perhaps of a flying bat, for he recorded no specimens from such a high elevation.

Conservation

Sherwin (no date, a) reported evidence of seemingly deliberate destruction of long-legged myotis roosting in an abandoned mine in north-central Utah in1994, followed by near-abandonment of this roost:

> A number of dead bats (*Myotis volans*) were found .... It appeared that the bats had been killed with rocks while roosting. Due to the severe trauma resultant from the way these bats were killed it was not possible to get an exact count of the number of dead animals. The conservative estimate is 15. Subsequent surveys have observed only single animals (both summer and winter) using this site.

Henny et al. (1982) reported pesticide residues(DDT and its break-down products) in *M. volans* after spraying to control larvae of Douglas-fir tussock moths was conducted in eastern Oregon. *M. volans* wa
s 1 of the 2 bat species that had the highest post-spray residues. Pesticide levels peaked in the bats' tissues 1 year after spraying, then decreased for the next 3 years, dropping to near pre-treatment levels by the 3rd year in most bat species but in *M. volans* remained significantly above levels in the non-spray (control) area.

Summary

- Taxonomy: uncertain (correct name may be *Myotis longicrus*)
- Utah subspecies: *M. v. interior*
- Utah distribution: all
- Utah wintering habits: unknown (but there are suggestions of possible migration and hibernation)

- Utah abundance: abundant
- Utah habitats: lowland riparian and desert shrub to montane coniferous forest
- Utah elevational range: 3,150 to $10,100 ft

Myotis californicus (Audubon and Bachman, 1842)
California myotis

Taxonomy

Two races of the California myotis have been identified in Utah. *Myotis californicus stephensi* is well known and widespread in southern and eastern Utah (e.g., see Bogan 1975, Hall 1981). Hall (1981), followed by Simpson (1993), assigned a Utah County specimen—and hypothetically any other populations in the northwestern part of the state—to the nominate race, *Myotis californicus californicus*.

Miller and Allen (1928), although they had only one record of this species in Utah, mapped the races *Myotis californicus pallidus* as occurring throughout the southwestern three-quarters of Utah and *Myotis californicus californicus* in the northeastern corners of the state (roughly Rich, Daggett, and eastern Summit counties). Because the name *pallidus* had earlier been applied to an Asian *Myotis* and thus was a junior homonym (under the International Code of Zoological Nomenclature), the new name *Myotis californicus stephensi* was proposed to replace it.

Myotis californicus is very similar to *Myotis ciliolabrum*, with which it is easily confused. Bogan (1974) discussed the problems of distinguishing these 2 bat species in the southwestern part of America, where their ranges overlap. He noted that "[i]n the Southwest ... no single qualitative character provides certain identification." He showed that a combination of several mensural characters will reliably distinguish the 2 species, but commented: "Proper identification, however, requires the presence of a clean, intact skull. It is disappointing that this study did not reveal any completely reliable character facilitating positive identification of these species in the field. Field identification still requires the utilization of traditional characters coupled with considerable experience." Because of the difficulty of identifying living examples of these 2 species in the field, Day and Peterson (1999a, 1999b) did not attempt to distinguish these 2 species in their Utah bat studies.

Constantine (1998), however, discussed a simple method of distinguishing living bats of these 2 species based on the presence of a free tail (i.e., projection of the tail 1.5–2.5 mm beyond the interfemoral membrane) in *M. ciliolabrum* and the absence of this character in *M. californicus*. His study was based mainly on bats from a relatively small area in California, and he cautioned:

> Notwithstanding the consistent presence of a free tail in *ciliolabrum* and its absence in *californicus* in the present study, and the other evidence that the same may be true elsewhere, additional studies representative of populations in other geographic

areas should be done, especially in view of the propensity of both species for geographic variation in other characters.

If this character proves to be as reliable in Utah—and throughout Utah—as Constantine reported it to be in northeastern San Bernardino County, California, and elsewhere, it will become an increasingly valuable method for bat researchers in this state as bat research continues to move away from the collecting of specimens and toward examination and release of live bats. However, even if this character is found to be reliable in Utah, it should be used together with other characters.

Woodman (1993) has argued that the generic name *Myotis* is feminine and that the specific name must, then, also be feminine, making the correct name for the California myotis *Myotis californica*. Pritchard (1994) has disagreed, and Jones et al. (1997) have pointed out that the International Commission on Zoological Nomenclature has designated *Myotis* as being masculine, and the name remains *M. californicus*.

Status in Utah

Distribution

The California myotis occurs nearly throughout Utah, being absent from the Uinta Mountains of northeastern Utah; records are also lacking from extreme north-central and northwestern Utah as well as from the mountains of the central part of the state (the Central High Plateaus).

As mentioned above, Miller and Allen (1928) mapped *M. californicus* as occurring throughout most of Utah. Durrant (1952) and Shuster (1957) considered the Utah distribution of the California myotis to include only the southern and eastern parts of the state, and Hall (1981) and Simpson (1993) mapped the hypothetical distribution of this species to include the southeastern half of the state—south and east of a line connecting the southwest corner (Washington County) and the northeast corner (Daggett County)—and the northwestern part of the state—from the vicinity of Utah Lake north into Idaho and west to the northwest corner of the state. Hasenyager's (1980) records of *M. californicus* were distributed in the southeastern half of Utah as well as in north-central Utah (Utah County) and extreme west-central Utah (extreme southwestern Tooele County).

Winter Habits

In the southwestern corner of Utah, *M. californicus* is known both to hibernate and to

be active during winter, even during cold periods, but its wintering habits in other parts of Utah are not known.

Twente (1960) noted that *M. californicus* had "not yet been reported as hibernating in Utah", and his investigations failed to demonstrate hibernation by the species in this state. Twente (1960) did suggest that among bats in southwestern Utah "hibernation may be temporary during cold periods" and they "apparently feed throughout the warmer periods of the winter (personal communication from Dean Stock), thus supplementing fat lost through hibernation." This has been corroborated by more recent work. Ruffner et al. (1979) have shown that bats in southwestern Utah, including very small species such as *M. californicus*, can be active in winter even when temperatures are cold. Near the Arizona border in extreme southwestern Utah, they (Ruffner et al. 1979) captured 2 active, flying individuals of *M. californicus* in winter when air temperatures were near and even below freezing. They reported: "These [*M. californicus*] were taken at ambient temperatures of –4E C on 3 January and 1E C on 5 January." They concluded that "[w]inter activity of bats in this region is a result of the poor quality of hibernacula." Poché (1981) mentioned winter captures of 3 California myotis at the same Utah locality during the periods November 19745 to March 1975 and January 1976; it is likely that the 2 individuals reported by Ruffner et al. (1979) were among those listed by Poché.

Stock (1965), however, reported that he collected 2 hibernating individuals of *M. californicus* "from a small cavern" in southwestern Utah on 12 February: "They were hibernating in a small hole in the ceiling of the cavern ...." He also reported collecting another hibernating California myotis in a mine shaft in southwestern Utah on 20 February: "The bat was handing [*sic*; hiding] in a small concavity of the ceiling ...."

Although they did not cite their sources, Barbour and Davis (1969) stated that *M. californicus* "[w]inters ... in Utah" and wrote: "This is one of the few species of western bats for which there are many winter records in the United States. They are known to hibernate in small numbers in mines in ... Utah ...; in spite of their scarcity in such situations, they are exceeded in numbers only by *Plecotus townsendii*."

Abundance

The California myotis is common in Utah.

Of 204 bat specimens from Utah examined by Hardy (1941), 3 (< 1.5%) were *M. californicus*; only 3 of the 15 bat species of which Hardy saw Utah specimens were less numerous.

Durrant (1952) also examined only 3 California myotis among 182 bat specimens from

Utah; *M. californicus* represented 1.6% of the total, and only 1 bat species of the 14 for which he had specimens was rarer.

Of 372 Utah bat specimens of 15 species examined by Shuster (1957), 10 (3%) were *M. californicus*, which ranked 10th in abundance.

Stock (1965), writing of the California myotis, stated: "This is the most common member of the genus *Myotis* in Washington County below 3,500 feet."

Hasenyager (1980) knew of approximately 60 individuals of the California myotis from Utah; this species represented 5% of the 1,212 Utah bats in his study and was the 8th most common of the 18 bat species.

Only 1 of 220 bats mist-netted by Lengas (1994b) in northern Utah was *M. californicus*, which was tied with one other species as the rarest of the 9 bat species that he caught.

Among 157 bats captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), 67 (43%) were the California myotis, which was the most abundant of the 10 bat species that were caught.

Of the 609 bats of 16 species captured by Jackson and Herder (1997) in southern Utah, 28 (5%) were *M. californicus*; 6 species were more abundant, 1 was tied with the California myotis, and 8 were rarer.

Mollhagen and Bogan (1997) captured 572 bats in the Henry Mountains of southern Utah, and, of these, 44 (8%) were *M. californicus*; it was the 7th most abundant of the 15 bat species that they netted.

Habitat

The California myotis is known in Utah from cities, towns, and ranches, and in a variety of natural habitats: lowland riparian, desert shrub, juniper–sagebrush, juniper, piñon–juniper, sagebrush–rabbitbrush, sagebrush–greasewood in a canyon and near piñon–juniper, montane grassland (grass–aspen), and mixed forest.

Krutzsch and Heppenstall (1955) reported, concerning *M. californicus* collected at a ranch in eastern Utah, that "[o]ne individual was taken from a roosting place in the bunkhouse and the second was shot at early twilight as it foraged low (15 ft. ±) over the horse corral."

Stock (1965) mentioned the presence of the California myotis in urban areas in

southwestern Utah: "They [*M. californicus*] are often seen catching insects attracted to street lights in St. George and other communities along the Virgin River. … They are attracted to street lights to feed much more than members of other [bat] species that are common in the area …."

Easterla (1965) mentioned that he collected *M. californicus* in a treeless, rolling area of sagebrush and rabbitbrush in southern Utah; 3–4 miles away there was ponderosa pine forest and mountainous terrain.

In southeastern Utah, Foster et al. (1997) captured the California myotis in montane grassland characterized by grasses and quaking aspen.

Lengas (1994b) mist-netted a California myotis in northern Utah in an area characterized by sagebrush and greasewood in a canyon bottom; piñon and juniper were present on the canyon walls.

Toone (1994) netted 1 *M. californicus* in southeastern Utah at a beaver pond in a meadow surrounded by mixed forest.

Jackson and Herder (1997) captured *M. californicus* in riparian (32%), desert shrub (12%), juniper–sage (7%), juniper (7%), and piñon–juniper (11%) habitats in southern Utah. (They also reported acoustic detection of the California myotis at a wet meadow in montane mixed forest.)

Captures of the California myotis have been reported in Utah from elevations as low as 2,600 feet (Stock 1965) and as high as 9,000 ft (Shuster 1965). (Durrant's [1952] record of this species at "297 ft." in Zion National Park is clearly a typographical error or printer's error. Jackson and Herder [1997] reported acoustic detection of *M. californicus* at 2,400 ft in extreme southwestern Utah.)

Conservation

Henny et al. (1982) reported that, after aerial spraying of DDT to control larvae of the Douglas-fir tussock moth in northeastern Oregon, *M. californicus* was 1 of the 2 bats that had the highest levels of pesticide residues and that continued to show high pesticide levels in its tissues 3 years after pesticide application.

Summary

- Utah subspecies: *M. c. stephensi* in s. and e., *M. c. californicus* in nw.

- Utah distribution: most of state except Uinta Mtns. of ne.; no records from extreme n.-c., nw., and mountains of c.
- Utah wintering habits: hibernates in mines and is active in winter in sw.; unknown in other parts of state
- Utah abundance: common
- Utah habitats: cities, towns, ranches, and lowland riparian and desert shrub to montane mixed forest
- Utah elevational range: #2,600 to 9,000 ft

Myotis ciliolabrum (Merriam, 1886)
western small-footed myotis

Taxonomy

This species was formerly considered to be part of a species known as *Myotis subulatus* (e.g., see Hardy 1941, Durrant 1952, Hall 1981), which was later called *Myotis leibii* (e.g., see Barbour and Davis 1969, Bogan 1974, Hasenyager 1980). Although Hall (1981) did not accept the name *M. leibii* at the specific level and declared that "certainly there are no differences between populations from the eastern United States and those from the western United States that warrant the recognition of two species", nearly all authors in recent years have referred eastern populations to *M. leibii* and western populations to the species *M. ciliolabrum*, Koopman (1993) being a notable exception.

Two subspecies of this bat have been considered to occur in Utah, *Myotis ciliolabrum ciliolabrum* (formerly *Myotis subulatus subulatus)* in part of northeastern Utah and *Myotis ciliolabrum melanorhinus* throughout the rest of the state. The presence of *M. c. ciliolabrum* (as *M. s. subulatus*) in northeastern Utah and *M. c. melanorhinus* (as *M. s. melanorhinus*) barely in southern Utah along the Arizona boundary was suggested by Miller and Allen (1928), although they had no specimens of either subspecies from Utah. Hardy (1941) assigned specimens from Utah to both of these subspecies. Although Durrant (1952) cited Hardy's (1941) record of *M. c. ciliolabrum* (as *M. s. subulatus)* from Carbon County, he commented that he had not seen the specimens, and his map for the race *M. c. melanorhinus* (as *M. s. melanorhinus*) includes, hypothetically, the area from which Hardy (1941) had reported *M. c. ciliolabrum* (as *M. s. subulatus*) (see Durrant 1952, Figures 8 and 17). Shuster(1957) also had not seen the Carbon County specimens reported by Hardy (1941), and, although she did include *M. c. ciliolabrum* (as *M. s. subulatus*) among the bats of Utah, she made it clear that she regarded the occurrence of that race in Utah to be questionable, writing: "If this subspecies [*M. s. subulatus* = *M. c. ciliolabrum*] actually occurs in that area [Carbon County] …" and "Doubt was cast [by Shuster] upon the presence of … *M. subulatus subulatus* in Utah." Hall (1981) accepted the Carbon County record as representing the race *subulatus* (i.e., *M. c. ciliolabrum*), which he mapped as occurring in Carbon, Duchesne, and parts of other counties in northeastern Utah; the rest of the state he considered to be in the range of the race *melanorhinus*.

Despite Durrant's (1952) apparent reservations concerning the presence of *M. s. subulatus* (= *M. c. ciliolabrum*) in northeastern Utah, Durrant and Dean (1960) assigned a specimen from adjacent Sweetwater County, Wyoming to this race "largely on the basis of geographic distribution." Reynolds (1966), apparently influenced by

Durrant and Dean's (1960) record from nearby in Wyoming, assigned 2 specimens of *M. subulatus* (= *M. ciliolabrum*) from Daggett County to *M. s. subulatus* (= *M. c. ciliolabrum*) based on color of ventral pelage and on geographical considerations.

The question of whether the race *M. c. ciliolabrum* truly occurs in Utah seems not yet to have been adequately resolved. Bogan and Cryan (2000), who examined 37 specimens of *M. ciliolabrum* from Sweetwater County, Wyoming, wrote: "Specimens available to us suggest that most Wyoming specimens represent the race *M. c. melanorhinus* and that *M. c. ciliolabrum* occurs only in the eastern prairie portions of Wyoming." If Bogan and Cryan (2000) were correct in their assessment of the distributions of the races of *M. ciliolabrum* that occur in Wyoming, then it seems very unlikely that *M. c. ciliolabrum* occurs in Utah at all. Certainly Bogan and Cryan (2000) were right that "[a] study of geographic variation in this species [*M. ciliolabrum*] would be of interest."

Hall (1981) did not agree with others concerning the specific distinction between the bats called by others *M. ciliolabrum* and *M. leibii* and commented: "... *M. s. subulatus* [= *M. c. ciliolabrum*] seems to differ more from *M. s. melanorhinus* [= *M. c. melanorhinus*] than does *M. s. leibii* [= *M leibii*]." This suggests that, if others (viz., van Zyll de Jong 1984) are correct that *M. ciliolabrum* and *M. leibii* are specifically distinct, *M. c. melanorhinus* should be elevated to full specific status as well. Concerning this, Bogan (1999) has written: "Considerable variation exists within bats representing *M. ciliolabrum* and there is the possibility that *M. c. melanorhinus* ... is distinct from nominate *ciliolabrum* (also see Hall, 1981)." If it is shown that the taxon *melanorhinus* deserves specific recognition, then some, and possibly all, bats currently referred to *M. ciliolabrum* in Utah will be known as *Myotis melanorhinus*, and bats assignable to *M. ciliolabrum* may or may not be present in northeastern Utah.

Koopman (1993) did not accept, and Koopman (1994) expressed reservations concerning, recognition of *M. ciliolabrum* as a species distinct from *M. leibii*. He did (Koopman 1994), however, comment: "It is possible that *ciliolabrum* and *melanorhinus* are specifically distinct from *leibii*."

The 2 species *M. ciliolabrum* and *M. californicus* are very similar and of all bat species that occur in Utah are the 2 most difficult to distinguish from each other. Two Utah specimens that Durrant (1952) examined and identified as *M. subulatus* (i.e., *M. ciliolabrum*), including one that he thought was an intergrade between *M. s. subulatus* (= *M. c. ciliolabrum*) and *M. s. melanorhinus* (= *M. c. melanorhinus*), were re-examined by Shuster (1957) and assigned by her to *M. californicus*. Shuster (1957) also listed 4 Utah "specimens assigned to *M. s. melanorhinus* (= *M. c. ciliolabrum*) which had some cranial characters of *M. c*[*alifornicus*] *stephensi*". She (Shuster 1957) wrote:

> It is possible that this intermediacy … may be due to hybridization. In other areas, however, where these two species are sympatric, no evidence of hybrids has been reported. Since both species have well differentiated subspecies, it is unlikely that they are conspecific. It is more probable that the cause of these intermediate animals is partly variation owing to age and partly some type of environmental or intrinsic pressures. The key to the problem can only be discovered when a larger series of these bats from Utah are studied.

Bogan (1974) studied morphological differences between *M. ciliolabrum* and *M. californicus* in New Mexico and found that "[t]hese analyses demonstrate the distinct nature of the two taxa." (See account of *M. californicus* for further discussion of the problem of distinguishing these 2 species.)

Status in Utah

Distribution

The western small-footed myotis occurs throughout Utah.

Miller and Allen (1928) had no records of *M. ciliolabrum* (as *M. subulatus*) from Utah, and they mapped this species' distribution as barely including northeastern Utah and extreme southern Utah. Although Durrant (1952) considered the "limits of distribution unknown" in Utah, he mapped records for the western small-footed myotis in southern and western Utah. Shuster (1957) thought that *M. ciliolabrum* (as *M. subulatus*) in Utah was "seemingly state-wide in distribution." Barbour and Davis (1969) and Hall (1981) mapped the distribution of this species (as *M. leibii* and *M. subulatus*, respectively) as including all of Utah. Hasenyager (1980) had records scattered across the state in 17 counties including the four corner counties—Box Elder, Daggett, San Juan, and Washington.

Winter Habits

M. ciliolabrum is known to hibernate in caves and mines in Utah.

Hardy (1941) reported "two specimens [of *M. subulatus* = *M. ciliolabrum*] from Kane County … taken January 27, 1940, from the walls of Crocodile Cave where each hung singly above the water", and he indicated that these bats were hibernating.

Twente (1960) mentioned: "Two specimens of *Myotis subulatus* [= *M. ciliolabrum*] have been found hibernating on each of three visits to Logan Cave, but have not been located elsewhere." He discussed this in more detail:

> *Myotis subulatus* [= *M. ciliolabrum*] have been found in different years on three occasions in January and February in one of the upper chambers of Logan Cave within 20 feet of the entrance. Two individuals were found each time, hanging singly on the wall in a practically dark situation. Body temperatures of the bats and ambient temperatures where they were found varied from 12.2E C to 13.0E C. It is doubted that these bats could survive the winter, although continuous temperature measurements at this place would be necessary to help determine this. ... Logan Cave is unique in the caves that have been explored in that it is an erosion cave caused by flowing water. Potentially, it is a good bat cave. Should other small openings be present to allow for some air circulation (which is usually the case with water erosion caves of this type), cool temperatures suitable for hibernation would exist. This does not seem to be true of Logan Cave, however, since there is little air circulation and temperatures in the dark zones are about 15E C., even in the coldest weather.

Stock (1965) disagreed with Twente (1960) and believed that this species may successfully hibernate in Logan Cave, noting that "two individuals were found in the same hibernacula on each of three different years" and "records indicate that these bats are better adapted to such situations than other members of the genus known to occur in Utah." Stock (1965) also considered Hardy's (1941) hibernation record for *M. ciliolabrum* from Crocodile Cave and commented: "This cave is also poor in terms of requirements for hibernation for small bats, but ... the area is far enough south to permit some feeding during the winter." He concluded: "Further study of the requirements for hibernation of these bats may shed new light upon the problem." Stock (1965) also reported another hibernation record for *M. ciliolabrum* in Utah. A specimen of this species "was taken in a small, dark cave in a lava flow, on Feb. 2, 1960; it was alone and was in deep hibernation. ... [T]he cave was only 10 feet deep and undoubtedly had a wide fluctuation of temperature. ... [T]his individual may have succeeded in overwintering in this cave by sporadic feeding, thus supplementing its lose [*sic*] of fat through hibernation."

Lengas (1997a) reported a western small-footed myotis hibernating in an abandoned mine in Sevier County on 8 February; the bat was 15 m from the portal, where the temperature was 6.4 EC and the relative humidity was 85%. Lengas (1997b) documented another hibernating *M. ciliolabrum* on 10 March in an abandoned mine in Tooele County; the bat was at the back of the adit, 21 m from the portal, where the temperature was 8.2 EC and the relative humidity was 64%.

Barbour and Davis (1969), including this species within what they referred to as *Myotis leibii*, noted that it "is one of the few bats known to hibernate in the West", where all populations are now considered *M. ciliolabrum*. They added (but perhaps concerning all bats formerly considered to be *M. leibii*, not strictly *M. ciliolabrum*): "The tolerance of this species for cold, relatively dry places for hibernation is remarkable for so small a bat. There are obviously some interesting problems in temperature regulation and water loss."

Abundance

Although the western small-footed myotis is known from many localities in Utah and is fairly common in some places, overall it is uncommon in this state.

Of the 204 bat specimens from Utah examined by Hardy (1941), 11 (5%) were *M. ciliolabrum* (as *M. subulatus*), and only 5 of the 15 bat species of which he saw specimens were more numerous than this species.

Durrant (1952) examined 182 Utah bat specimens, of which 7 (4%) were considered to be the western small-footed myotis (as *M. subulatus*); it was the 8th most abundant of the 14 species of bats for which he looked at specimens. Shuster (1957) re-identified 2 of his specimens as another species; correcting his data for these reassigned specimens (and 1 other) results in 5 (3%) *M. ciliolabrum*, which becomes tied with *M. californicus*, and 8 of the (corrected) 15 bat species were more common than these 2.

Of 372 Utah bat specimens examined by Shuster (1957), 24 (6%) were *M. ciliolabrum* (as *M. subulatus*), which ranked 6th in abundance of the 15 bat species of which she saw Uta specimens.

Stock (1965) found *M. ciliolabrum* (as *M. subulatus*) to be common in Washington County, where he often observed them in great numbers.

Hasenyager (1980) compiled Utah records of 45 (or more) individuals of *M. ciliolabrum* (as *M. leibii*); this species represented 4% of all Utah bats and ranked 11th in abundance of the 18 bat species in his Utah study.

Hallows (1982) considered this species (as *M. subulatus*) to be 1 of the 2 most common bats in Bryce Canyon National Park.

Of 220 bats mist-netted in the Ashley National Forest of northern Utah by Lengas (1994b), 6 (3%) were *M. ciliolabrum*, which ranked 6th in abundance of the 9 bat species that he captured.

Among 157 bats captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), 15 (10%) were the western small-footed myotis; it ranked 4th in abundance of the 10 bat species that were caught.

Mollhagen and Bogan (1997) wrote that *M. ciliolabrum* “does not appear to be particularly common in the Henry Mountains”. Only 8 (1.4%) of the 572 bats that

they mist-netted there were this species, and of the 15 bat species that they caught, this bat was only 13th in abundance.

Of 609 bats captured and identified in southern Utah by Jackson and Herder (1997), 26 (4%) were the western small-footed myotis; it was the 9th most abundant of the 16 bat species that they caught.

Habitat

In Utah the western small-footed myotis inhabits a variety of habitats including: lowland riparian, desert shrub, juniper–sagebrush, juniper, piñon–juniper, sagebrush–rabbitbrush, sagebrush–greasewood (near piñon–juniper), highland riparian in lodgepole pine forest, montane forest and woodland (Douglas-fir–aspen), and montane grassland (grass–aspen). A night roost in Utah was in an abandoned mine.

Working in Washington County, Stock (1965) found *M. ciliolabrum* (as *M. subulatus*) to be especially common above 3,500 ft elevation and commented: "At higher elevations, they [*M. ciliolabrum*] replace *Myotis californicus* as the dominant small *Myotis*. Most individuals were taken near streams or lakes ...."

Easterla (1965) reported collecting *M. ciliolabrum* (as *M. subulatus*) in southern Utah in a treeless, rolling landscape of sagebrush and rabbitbrush 3–4 miles from montane ponderosa pine forest.

Lengas (1994b) mist-netted the western small-footed myotis in northern Utah in a riparian situation with willows surrounded by lodgepole pine forest (17%) and in a canyon with sagebrush and greasewood in a canyon bottom and piñon and juniper on the canyon walls (83%). Lengas (1997a) reported finding 1 *M. ciliolabrum* at a night roost in an abandoned mine in Piute County on 22 July at 0015 hours.

Foster et al. (1997) captured *M. ciliolabrum* in southern Utah in montane grassland (grass–aspen), montane forest and woodland (Douglas-fir–aspen).

Jackson and Herder (1997) captured the western small-footed myotis in southern Utah in riparian (23%), desert shrub (8%), juniper–sagebrush (4%), juniper (12%), and piñon–juniper (15%) habitats; 1 site for which they did not specify habitat accounted for 38% of their captures. (They also reported acoustic detection of *M. ciliolabrum* at a dry meadow and in ponderosa pine forest.)

The range of reported elevations at which *M. ciliolabrum* has been captured in Utah is 2,950 ft (Stock 1965) to 8,900 ft (Mollhagen and Bogan 1997).

Conservation

Abandoned mines provide important roosts and hibernacula for the western small-footed myotis in Utah. The Abandoned Mine Reclamation Program of the Utah Division of Oil, Gas and Mining carries out closures of abandoned mines in Utah for human safety; however, careful surveys for bats in mines scheduled for possible closure are conducted during both warm and cold seasons to ensure that abandoned mines that are used by bats are not closed but rather are gated (M. R. Mesch, pers. comm.).

Summary

- Taxonomy: uncertain (correct name may eventually prove to be *Myotis melanorhinus* or could even revert, though very doubtfully, to *Myotis leibii*)
- Utah subspecies: 1 (possibly 2), *M. c. melanorhinus*, *(M. c. ciliolabrum* reported but questionable)
- Utah distribution: all
- Utah wintering habits: hibernates in caves and mines
- Utah abundance: uncommon
- Utah habitats: lowland riparian and desert shrub to montane forest
- Utah night roosts: mines
- Utah elevational range: 2,950 to 8,900 ft

Lasiurus blossevillii (Lesson and Garnot, 1826)
western red bat

Taxonomy

Although this bat is still regarded by a few mammalogists as conspecific with *Lasiurus borealis* (Koopman and McCracken 1998, Shump 1999), in which it was formerly placed as a subspecies, most recent authors have accorded it full specific status based on the works by Baker et al. (1988) and Morales and Bickham (1995). Much of the literature pertaining to this bat in Utah has discussed it using the name *Lasiurus borealis* (e.g., Hardy 1941, Durrant 1952, Shuster 1957, Hasenyager 1980).

Presnall and Hall (1938), reporting this bat for the first time in Utah, called it *Nycteris borealis*. Hall and Kelson (1959) and Hall (1981) placed all *Lasiurus* in the genus *Nycteris*, the name that has priority and thus, at least in principle, should apply to this genus. However, in 1913 the International Commission on Zoological Nomenclature curiously suspended the rules of priority in this case, which resulted in the current usage of *Lasiurus* (see Hall 1981 for discussion).

The race that occurs in Utah is *Lasiurus blossevillii frantzii*. Most of the Utah literature pertaining to this bat is old enough that the trinomial in use was *Lasiurus borealis teliotis* (e.g., Presnall and Hall 1938, Hardy 1941, Durrant 1952, Shuster 1957). Morales and Bickham (1995), however, synonymized the race *teliotis* with *frantzii*, which is an older name and thus has priority.

Morales and Bickham (1995) also noted differences between *L. b. blossevillii* and *L. b. frantzii* and suggested that "these two forms might be different species, although more samples from Central and South America are needed to confirm this hypothesis." If it were shown that *blossevillii* and *frantzii* are separate species, red bats in Utah would come to be known as *L. frantzii*, which would comprise no subspecies (unless *teliotis* were resurrected or a new subspecies were proposed, neither of which seems likely).

Status in Utah

Distribution

The few Utah localities for the western red bat are in north-central, central, and southwestern Utah. Although there are too few Utah records of this species to draw

any strong distributional conclusions, it appears that *L. blossevillii* ranges in a north–south band through the state, from extreme north-central Utah (Cache County), south through the center of the state (Utah and Carbon counties), thence southwest to the southwest corner (Washington County).

Early authors (e.g., Durrant 1952, Shuster 1957) mapped the hypothetical Utah range of this bat as including most of the southeastern half of the state, based, however, only on several records from Washington County and one report from Carbon County in1937 (Hardy 1941). Concerning this species in Utah, Durrant (1952) provided the comment, "limits of range unknown." Shuster (1957) opined: "With further collecting its range will doubtless be found to include the southern two-thirds of the state in proper habitat." Barbour and Davis (1969) mapped the distribution of *Lasiurus borealis* more conservatively as extending from southwestern Utah (Washington County) northeastward to central Utah (Carbon County).

Hall (1981), using the same Utah records as Durrant (1952) and Shuster (1957) (i.e., those in Washington and Carbon counties), mapped the hypothetical distribution in Utah somewhat differently from those authors; although he included much of southern and eastern Utah as had others, he indicated this bat's range as reaching north in east-central Utah to the southwest corner of Wyoming (i.e., Summit County, Utah) and in eastern Utah ending in a north–south line just west of the Colorado boundary and thus not reaching Colorado from the west.

A specimen record from Utah County in the north-central part of the state, and not very far from the Carbon County location, has recently been published (Mollhagen and Bogan 1997). A verbal report of the capture of this species in Cache County (B. J. Lengas and E. Owens, pers. comms.) extends the Utah distribution even farther north in north-central Utah toward the Idaho boundary.

Within the hypothetical distribution of this species in southern and eastern Utah that has been proffered by the several authors mentioned above (i.e., Durrant 1952, Shuster 1957, Hall 1981), Mollhagen and Bogan (1997) have suggested that there may be gap: "There are no records of the western red bat anywhere near the Henry Mountains, and work nearby (Bogan, unpublished data) suggests that this species is absent or very uncommon in this part of Utah. Previous records ... are at least 150 mi from the Henry Mountains."

Wintering Habits

The wintering habits of the western red bat in Utah are unknown. Some bat researchers have hypothesized or assumed that *L. blossevillii* is migratory in Utah, as would be expected of this species, but no conclusive evidence of this is available.

Twente (1960), who investigated hibernation of bats in Utah, asserted that this species, which he treated as *L. borealis*, was known to be migratory elsewhere in its range and had not been recorded in Utah except during the warmer months. It does seem likely that *L. blossevillii* is migratory, but, since it has been distinguished as a species separate from *L. borealis*, generalizations about it from the much better known habits of the latter species are no longer justified, despite the close relationship of these 2 species.

Hasenyager (1980) wrote: "A. D. Stock (1965) collected one [*L. borealis*] on 1 November 1948, in St. George, documenting their presence in Utah during the winter." However, the date referenced by Hasenyager (1980) does not appear in the account of this species by Stock (1965). Stock (1965) did list 3 specimens of this species from St. George, and in his text he mentioned 2 from St. George from the work of Hardy (1941), which is in agreement with the original source (Hardy 1941), and these records must of course be from before 1948, and another from St. George collected by Stock himself in May 1958. Thus none of Stock's (1965) records of this species from St. George is unaccounted for, and none corresponds to the record attributed to him by Hasenyager (1980). Because the date mentioned by Hasenyager (1980) is of considerable interest, it seems unlikely that Stock (1965) would not have mentioned it and commented on it in his discussion of this species if he had been the collector or even if he had known of such a record. Since the November record is not supported by Hasenyager's (1980) referenced source, it could be viewed as erroneous. However, there is a specimen of *L. blossevillii* in the collection of Dixie College (DC 2023) that bears the date, locality, and collector stated by Hasenyager (A. H. Barnum, pers. comm.).

It is strange that Stock would have forgotten or overlooked such an important record in his study of the mammals of Washington County. In Stock's (1965) introduction to his work, he wrote:

> The information found herein is based in part on preliminary observations in the area during a period of time beginning in early 1955 and extending to early 1960, during which time I resided in St. George, Washington County, Utah. More intensive field work was accomplished during the summer of 1963 ....

From this it appears questionable whether Stock was in St. George in 1948.

Also, Stock (1965) reported collecting a red bat at Terry's Ranch in the Beaver Dam Wash on 24 March 1957 but indicated that the specimen, which was in the Dixie College collection, had possibly been lost. The mammal collection of the University of Kansas contains a specimen of *L. blossevillii* (KU 150345), accessioned as part of the large collection of the late Albert Schwartz (no. 5063), collected in the vicinity of St. George on 3 April 1957 by A. D. Stock (no. 1006) (T. Holmes, pers. comm.).

Stock (1965) listed 1 of the 4 red bat specimens that he examined from Washington County as "1 AS" and earlier in the same work had noted: "One specimen of *Lasiurus borealis* collected by me is now in the private collection of Dr. Albert Schwartz (AS)." It is nonetheless puzzling that Stock (1965) did not discuss this bat, taken only 10 days after the March 1957 specimen.

Stock (1965) did provide discussion of the 2 red bats that he collected in Washington County on 24 March 1957 and in May 1958. In a summary comment he wrote: "It may be that these were migrating individuals ...." The May 1958 specimen, which from Stock's (1965) account would seem to have been in the Dixie College collection, does not match the collecting date of either of the 2 red bats now in that collection, although there is a specimen in that collection collected "prior to May 1938", with no collector specified (A. H. Barnum, pers. comm.). Despite the questions concerning Stock's (1965) account of the red bat in Washington County, it does appear that *L. blossevillii* has been collected there during times that are suggestive of migration or perhaps even of overwintering.

The Utah County specimen of *L. blossevillii* (BYU 13319) mentioned by Mollhagen and Bogan (1997), was collected 28 October 1991 (W. Skidmore, pes. comm.). This date, too, is suggestive of migration.

Concerning the presence of *L. blossevillii* in Utah, Mollhagen and Bogan (1997) opined: "We surmise that this migratory species occurs only rarely in most of Utah, although there may be predictable seasonal populations in Washington County during the summer months."

Abundance

The western red bat is one of the rarest mammals known from Utah and is the rarest of the 18 species of bats known to occur in this state.

Hardy (1941) examined 204 bat specimens from Utah, of which 11 (5%) were *L. blossevillii*; only 5 of the 15 bat species of which he saw Utah specimens were more numerous. However, 6 of these 11 Utah specimens were juvenile bats, evidently still nursing and probably clinging to their mothers (2, each with 3 young). Inclusion of juveniles biases the apparent abundance of this species in Utah relative to other species, for which juveniles were not included among the specimens examined. If the juveniles are disregarded, Hardy looked at 5 (2.5%) *L. blossevillii* among 198 specimens, and this species ranks 10th in abundance of the 15 species.

None of the 182 Utah bat specimens examined by Durrant (1952) and none of the 372

examined by Shuster (1957) was the western red bat. Writing of *L. blossevillii* (as *L. borealis*) in Utah, Shuster (1957) noted: "This bat is rare within the state."

Hasenyager (1980) evidently did leave the 6 juveniles out of his count of *L. blossevillii* in Utah. He listed Utah records of 8 individuals of this species, which represented only 0.66% of the total of all bats, and *L. blossevillii* was 17th in abundance among the 18 bat species in his study.

Lengas (1994b) mist-netted 220 bats of 9 species in the Ashley National Forest of northern Utah but did not capture *L. blossevillii*. Although his work was within the hypothetical distribution of this species as mapped by Hall (1981), it is uncertain whether *L. blossevillii* should be expected in the areas sampled by Lengas (1994b).

Of 157 bats of 10 species captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), none was the western red bat; however, it is doubtful that an adequate extent of habitat suitable for *L. blossevillii* is present within the area sampled.

In recent years several major bat studies have been conducted in southern Utah within the known or presumed range of *L. blossevillii* (as mapped by Hall 1981). Pritchett (no date) and co-workers mist-netted 264 (or 265) bats of 10 species at 4 locations in southern Washington County in 1991. Mollhagen and Bogan (1997), in 94 net-nights at 22 localities in the Henry Mountains region of southern Utah, caught 572 bats of 15 species. Jackson and Herder (1997) sampled 42 locations in southern Utah and captured and identified 609 bats of 16 species, in addition to their use of ultrasonic detection devices. Day and Peterson (1999a) mist-netted 28 sites in south-central Utah, capturing 640 bats of 13 or 14 species. Day and Peterson (1999b) used mist nets at 11 locations in southwestern Utah and caught 179 bats of 10 or 11 species. Four of these studies included a wide range of elevations and habitats in the mist-net sampling that was done, and sampling sites were distributed in several Utah counties. Of the 2,264 or 2,265 bats captured in these 5 investigations, not one was *L. blossevillii*. Moreover, *L. blossevillii* was the only bat species known to occur in Utah that was not captured in any of these 5 studies.

Habitat

The western red bat has been reported in Utah from towns and cottonwood groves in lowland riparian areas. However, habitats at the 3 locations where this species has been captured in northern Utah (Carbon, Utah, and Cache counties) have not been reported; at least 1 of these (Carbon County) was at moderately high elevation. Reported roosts in Utah have been a cave and a mine.

The first report of the western red bat in Utah and perhaps the most interesting of all

Utah records of this bat, being a breeding record—2 adult females, each with 3 young—provided no habitat information other than that the collection site was at 3,000 ft elevation (Presnall and Hall 1938). Although the locality stated by Presnall and Hall (1938) for that record was merely "LaVerkin, 3000 ft., Washington County, Utah", Hardy (1941), citing Presnall and Hall (1938), gave the locality as "LaVerkin Cave", and this has been repeated by others (e.g., Durrant 1952, Shuster 1957, Stock 1965, Hasenyager 1980). Since Hardy (1941) listed the same record again among the specimens that he examined, it would seem plausible that he may have obtained the additional information concerning the cave from specimen labels, but, for the specimens, he stated the locality as only "LaVerkin". Because bats of the genus *Lasiurus* seldom roost in caves, Hardy's (1941) assertion that Presnall and Hall's (1938) record of *L. blossevillii* was from a cave is of considerable interest, and it is unfortunate that Hardy (1941) provided no explanation of his augmentation of Presnall and Hall's (1938) data. Since Hall was well aware of that a record of this bat from a cave would have been of particular interest and stated that this and a related species were "tree-inhabiting" bats (Hall 1946), it is all the more curious that, in the publication that he co-authored with Presnall in 1938, no mention was made of a cave.

Hardy (1941) also reported a new Utah record of *L. blossevillii* from Kenilworth Mine, Carbon County. He commented: "The two Kenilworth specimens were found September 17, 1937, hanging on the walls of a mine not far from the entrance." Hardy (1941) mentioned, too, a western red bat that was found dead on the ground near the Virgin River in St. George, which would place it in a lowland riparian habitat.

Stock (1965) reported that on 2 occasions he collected *L. blossevillii* southwestern Utah that were actively foraging among cottonwoods "in full light of late afternoon." From the localities mentioned, it is apparent that at least one of the groves of cottonwoods was in a lowland riparian area. Stock (1965) also documented specimens of *L. blossevillii*, including at least 1 that he collected, from St. George, as had Hardy (1941).

The extremes of elevations reported for this bat in Utah are 2,650 ft (Stock 1965) and 3,000 ft (Presnall and Hall 1938). Although the elevation was not reported for the Carbon County record (Hardy 1941), Kenilworth Mine has been located on topographic maps, the elevation being 6,760 ft elevation.

While it is disappointing that so little has been reported concerning the habitats of the few western red bats that have been found in Utah, the little that has been documented concerning the Utah habitats and behavior of this species is quite surprising and challenges assumptions about this bat's habits. First, *L. blossevillii*, like other members of the genus *Lasiurus*, is generally considered to be a solitary rather than a social or colonial species; thus it is of interest that 2 of the Utah records of *L. blossevillii* pertain to 2 adults roosting in association with each other. Second, *L.*

blossevillii, again like other species of *Lasiurus*, is considered to be a tree- or foliage-roosting bat, and the Utah records of *L. blossevillii* from a mine and from a cave are noteworthy exceptions to this. Finally, that 2 of the Utah records of this species were of individuals foraging during the daytime is of interest.

Conservation

The continuing loss of riparian habitat in the Virgin River drainage of Washington County, where most of the Utah records of the western red bat are from, may be a threat to this species in Utah.

Summary

- Taxonomy: uncertain—some still consider this bat to be *Lasiurus borealis*; others suggest that it may even be specifically distinct from *L. blossevillii*, in which case it would be called *L. frantzii*
- Utah subspecies: *L. b. frantzii* (but if the species is *L. frantzii*, it would have no subspecies)
- Utah distribution: the few records suggest a n.–s. band from extreme n.–c. (Cache County) through c. (Utah and Carbon counties) to extreme sw. (Washington County)
- Utah wintering habits: unknown (believed to migrate out of Utah, and some evidence suggests this)
- Utah abundance: very rare
- Utah habitats: towns, cottonwood groves in lowland riparian situations, probably others
- Utah maternity roosts: a cave
- Utah diurnal roosts: a mine
- Utah elevational range: 2,650 to 6,760 ft

Lasiurus cinereus (Palisot de Beauvois, 1796)
hoary bat

Taxonomy

Hall (1981) referred to this species as *Nycteris cinerea*, pointing out that the generic name *Nycteris* has priority over *Lasiurus* (see account of *Lasiurus blossevillii*).

The subspecies of the hoary bat that occurs in North America is *Lasiurus cinereus cinereus*, the nominate race (see Hall 1981, Shump and Shump 1982).

Status in Utah

Distribution

The hoary bat occurs throughout Utah.

Nearly all authors (e.g., Durrant 1952, Shuster 1957, Barbour and Davis 1969, Hasenyager 1980, Hall 1981, Shump and Shump 1982) have considered *L. cinereus* to be of statewide occurrence in Utah.

Wintering Habits

The hoary bat seemingly migrates out of Utah for the winter, although a record suggestive of possible overwintering in southwestern Utah has been reported. Information addressing the Utah wintering habits of *L. cinereus* (e.g., from winter recoveries elsewhere of individuals banded in Utah) would be desirable.

Hardy (1941) thought that hoary bats in Utah "probably migrate before winter." Twente (1960) included *L. cinereus* among the bats that "are known to be migratory elsewhere in their geographic ranges and have not been reported from Utah except during the warmer months."

Barbour and Davis (1969) commented: "*L. cinereus* is one of our most accomplished migrants." They added, however: "Although strong circumstantial evidence for migration of this species is abundant, we as yet have no direct evidence of specific movements or migration paths or patterns." They also reviewed some evidence suggestive of overwintering in northern areas and even hibernation. Similarly, Shump

and Shump (1982) wrote: "Although there is much circumstantial evidence to support the assumption that *L. cinereus* migrates, wintering sites are not well documented and no specific migration routes have been plotted. ... Some hoary bats probably remain in northern areas and hibernate ...."

Stock (1965) noted: "Records of Zion National Park collection include a report of a hoary bat found dead in Refrigerator Canyon on February 15, 1963. I have not seen this specimen and do not know if it was preserved for study. If the bat was freshly dead, the above date suggests that it was wintering in this area."

Mollhagen and Bogan (1997) mentioned that a female hoary bat that they captured in southern Utah in late May was probably in migration.

Abundance

The hoary bat is uncommon in Utah.

Among the 204 Utah bat specimens examined by Hardy (1941), 6 (3%) were *L. cinereus*; 8 (or 7, if juveniles are excluded) of the 15 bats for which he saw specimens were more numerous.

Durrant (1952) looked at 4 (2%) specimens of hoary bats among the 182 Utah bat specimens that he examined; this species ranked 10th (or 11th, if corrections based on later re-identifications are made) of the 14 (actually 15) bat species for which he had specimens.

Of the 372 bat specimens from Utah that Shuster (1957) examined, 6 (1.6%) were *L. cinereus*, which was 12th in abundance of the 15 species of which she saw specimens.

Hasenyager (1980) assembled records of at least 16 individuals of the hoary bat in Utah; of the 18 bat species in his Utah study, this was 15th in order of abundance and represented 1.3% of all individuals.

Pritchett (no date) and co-workers mist-netted 264 or 265 bats in southern Washington County "between 13 May and 22 June 1991"; 19 (7%) of these were *L. cinereus*, which was the 4th most numerous of the 10 species that they caught.

Of 220 bats mist-netted in the Ashley National Forest of northern Utah by Lengas (1994b), 4 (2%) were *L. cinereus*, which was the 7th in abundance of the 9 species captured.

Only 1 (0.6%) of 157 bats captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996) was a hoary bat; it was tied with 3 other bats as the rarest of the 10 species that were caught.

Mollhagen and Bogan (1997) mist-netted 572 bats in the Henry Mountains of southern Utah but caught only 2 individuals (0.3%) that were this species; it ranked 14th out of 15 bat species in order of abundance.

Only 4 (0.7%) of the 609 bats captured and identified by Jackson and Herder (1997) in southern Utah were *L. cinereus*; of the 16 species that they caught, only 2 were rarer than the hoary bat.

In their bat inventory of the Grand Staircase–Escalante National Monument in southern Utah, Day and Peterson (1999a) mist-netted 640 bats, and only 3 (0.5%) were *L. cinereus*; this species tied with 2 others as the rarest of the 13 kinds of bats (13 or 14 species) that they netted. None of the 179 bats of 10 kinds (10 or 11 species) captured by Day and Peterson (1999b) in southwestern Utah was this species.

Habitat

In Utah the hoary bat utilizes a range of habitats that include: lowland riparian, desert shrub, sagebrush–greasewood (near piñon–juniper), lodgepole pine forest, montane grassland (grass–aspen), and montane forest and woodland (grass–spruce–aspen). It is also known from towns and cities in Utah.

Stock (1965) reported that near the Virgin River south of St. George he found a hoary bat "hanging about 12 feet above the ground in a cottonwood tree, in nearly full sunlight." He commented, perhaps because of the strong light on the bat, that he doubted that this was a natural roosting situation. Stock (1965) also mentioned another *L. cinereus* that he found "inside a service station rest room in St. George." Others, too, have listed records of the hoary bat in various towns and cities in Utah (e.g., Hardy 1941, Crane 1948, Durrant 1952, Shuster 1957, Hasenyager 1980); at least some of these records probably are not generalizations of the localities to the nearest towns but actually represent urban occurrences.

Pritchett (no date) and co-workers netted the hoary bat at 3 sites in southwestern Washington County; the habitats were riparian situations in warm desert shrub communities at 2 of these locations (42%) and "mountainous, riparian habitat" at the 3rd site (58%).

In the Ashley National Forest of northern Utah, Lengas (1994b) mist-netted *L. cinereus* at 3 locations in lodgepole pine forest—a dry meadow (25%), a riparian area with

willows and aspens (25%), and a spring-fed pool with willows and aspens (25%)—and a 4th site that was in sagebrush–greasewood habitat in a canyon bottom, with piñons and junipers on the canyon walls (25%).

In southern Utah, Foster et al. (1997) captured *L. cinereus* in montane forest and woodland (grass–spruce–aspen) and in montane grassland (grass–aspen).

Jackson and Herder (1997) caught the hoary bat in 2 riparian situations (100%) in southern Utah. (They also detected this bat acoustically in desert shrub, ponderosa pine forest, and at a wet meadow in mixed forest.)

Day and Peterson (1999a) mist-netted *L. cinereus* in riparian (67%) and desert shrub (33%) habitats in the Grand Staircase–Escalante National Monument of southern Utah.

Extremes of reported elevations where *L. cinereus* has been captured in Utah are about 2,500 ft (Pritchett no date) and 9,200 ft (Foster et al. 1997).

Conservation

Timber harvest and alteration and degradation of riparian habitats are potential threats to the hoary bat in Utah.

Summary

- Utah subspecies: *L. c. cinereus*
- Utah distribution: all
- Utah wintering habits: apparently migrates; possibly overwinters in sw.
- Utah abundance: uncommon
- Utah habitats: lowland riparian and desert shrub to montane forest; also towns, cities
- Utah roosts: a tree
- Utah elevational range: -2,500 to 9,200 ft

Lasionycteris noctivagans (Le Conte, 1831)
silver-haired bat

Taxonomy

Shuster (1957) consistently misspelled the specific epithet as *noctivigins*, even in her synonymy for this species, seemingly attributing this spelling to other authors including the author of the type description and thus of the name itself.

Durrant (1952) called this species the silvery-haired bat.

Lasionycteris noctivagans is monotypic (i.e., it has no subspecies) (Kunz 1982). Moreover, the genus *Lasionycteris* itself is monotypic, containing the single species *L. noctivagans*.

Status in Utah

Distribution

The silver-haired bat occurs throughout Utah, as has been indicated by many authors (e.g., Durrant 1952, Shuster 1957, Barbour and Davis 1969, Hasenyager 1980, Hall 1981, Kunz 1982).

Wintering Habits

The silver-haired bat is presumed to migrate out of Utah for the winter; however, a winter record of this bat in southwestern Utah has been reported.

Twente (1960) considered *L. noctivagans* to migrate into and out of Utah, stating that this is a species that is known to be migratory elsewhere and for which all Utah records are from the warmer months. However, even in 1960 it was not true that all Utah reports of *L. noctivagans* had been from the warmer months. Hardy (1941), whom Twente (1960) cited, reported a specimen of *L. noctivagans* from St. George that "was found the morning of December 14, 1939, hanging on the stone wall at the entrance of the Woodward High School building. It seemed in semi-hibernation in the chill of the morning air." Since some bats are active during all seasons in extreme southwestern Utah, it is difficult to evaluate this record. It does demonstrate, at the least, that not all silver-haired bats leave Utah for the winter.

Stock (1965) also cited Hardy (1941) but made no mention of the mid-December record of *L. noctivagans* from Washington County. He did, however, state: "In Washington County, these bats are found at higher elevations in summer, usually above 4,000 feet, but migrate to lower elevations in the fall. No hibernating individuals have been found in the study area and presumably they go farther south in winter."

In addition to the mid-December record, Hardy (1941) also reported October records of this species—1 from northern Utah (Salt Lake City) and 1 from southwestern Utah (St. George)—and it is possible that these were migrating individuals.

Day and Peterson (1999b), concerning *L. noctivagans* in their southwestern Utah study, commented: "This bat is a common summer resident, but migrates south in fall. … Those caught in June [i.e., 29 June] were probably [spring] migrants."

Izor (1979) considered the winter range of *L. noctivagans* and concluded: "… [S]ilver-haired bats may occur during the winter in suitable caves anywhere in the United States except perhaps the extreme northern Midwest and Great Plains. They will also use trees and buildings north to approximately the limit of the 20EF (–6.7EF) mean daily minimum isotherm for January." His figure showed this isotherm as running almost through St. George, which was the location of Hardy's (1941) winter record for this species in Utah.

Abundance

The silver-haired bat is common in Utah.

Of 204 Utah bat specimens examined by Hardy (1941), 8 (4%) were *L. noctivagans*, which was the 8th (or 7th, if juveniles are excluded from Hardy's numbers) in abundance of the 15 species for which he saw Utah specimens.

Durrant (1952) examined 182 bat specimens from Utah; of these, 6 (3%) were silver-haired bats, and this species was 9th in abundance of the 14 species of which he saw Utah specimens (or 8th of 15 species if his data are corrected for a later re-identification).

Of the 372 Utah bat specimens of 15 species examined by Shuster (1957), 16 (4%) were *L. noctivagans*, which ranked 9th in abundance of the 15 species.

Although Jensen (1965) had only 3 specimens of *L. noctivagans* from Rich County, he considered the species to be "common throughout the mountainous part" of the county.

Hasenyager (1980) compiled Utah records of more than 48 individuals of *L. noctivagans*. It represented 4% of the bats in his Utah study and was the 10th most common bat of the 18 Utah species.

Of 264 or 265 bats mist-netted in southern Washington County in 1991 by Pritchett (no date) and co-workers, 5 (2%) were the silver-haired bat, which ranked 8th in abundance of the 9 bat species that they caught.

Lengas (1994b) mist-netted 220 bats of 9 species in the Ashley National Forest of northern Utah; 57 (26%) of these bats were *L. noctivagans*, which was the 2nd most abundant species.

Of the 157 bats of 10 species captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), none was the silver-haired bat.

Of 572 bats mist-netted in the Henry Mountains by Mollhagen and Bogan (1997), 71 (12%) were *L. noctivagans*; only 2 other bats of the 15 species that they captured were more abundant.

Only 4 (0.65%) of the 609 bats of 16 species caught and identified by Jackson and Herder (1997) in southern Utah were *L. noctivagans*, and only 2 species of bats were rarer among the species that they captured.

In the Grand Staircase–Escalante National Monument of southern Utah, Day and Peterson (1999a) mist-netted 640 bats; 15 (2%) of these were *L. noctivagans*, and this species was 9th in abundance of the 13 kinds of bats (13 or 14 species) that they captured.

Among the 179 bats that Day and Peterson (1999b) captured in southwestern Utah, 22 individuals (12%) were the silver-haired bat, and only 1 other species of the 10 kinds of bats (10 or 11 species) was more abundant in their study.

Habitat

The silver-haired bat has ben reported in Utah from a variety of habitats that include: lowland riparian, desert shrub, piñon–juniper, sagebrush–rabbitbrush, sagebrush–greasewood near piñon–juniper, sagebrush–grass in mixed forest, a grassy park with willows near mixed tress and sagebrush, a cottonwood grove, lodgepole pine forest, ponderosa pine forest, mixed coniferous forest, mixed aspen–coniferous forest, and alpine meadow. This bat also has been found in towns and cities in Utah.

Hardy (1941) mentioned a *L. noctivagans* that "was found … as it hung on the side

of a large boulder near the water" in a canyon in Carbon County. He also reported individuals of this species that were found in Utah cities and towns—1 on the University of Utah campus in Salt Lake City and another in a garage in St. George.

Krutzsch and Heppenstall (1955) reported 2 silver-haired bats that were shot in northeastern Utah as they foraged "over an open, grassy, alpine meadow" and "over the Green River".

Ranck (1961) collected a silver-haired bat in a riparian situation (tamarisk, willow, and cottonwoods) along the White River in eastern Utah.

Easterla (1965) collected *L. noctivagans* in southern Utah in a treeless, rolling area of sagebrush and rabbitbrush; there was ponderosa pine forest a few miles away.

Reynolds (1966) reported that he shot a silver-haired bat in Daggett County "as it circled about a grove of narrow-leaf cottonwoods (*Populus angustifolia*)".

Pritchett (no date) and co-workers captured *L. noctivagans* in southwestern Washington County in "mountainous riparian habitat" (60%) and warm desert shrub (40%).

Lengas (1994b) mist-netted the silver-haired bat in the Ashley National Forest of northern Utah in lodgepole pine forest (16%), mixed coniferous forest (18%), mixed aspen–coniferous forest (2%), a canyon with sagebrush and greasewood in the bottom and piñon and juniper on the walls (12%), a riparian situation with willows and aspens in a steep canyon (47%), and a small grassy park with willows and nearby mixed stands of trees as well as sagebrush, mountain mahogany, Douglas-fir, and lodgepole pine on the slopes (5%).

Toone (1994) captured a silver-haired bat in southeastern Utah at a beaver pond surrounded by a meadow in mixed forest.

Foster et al. (1997) mist-netted *L. noctivagans* in southern Utah in habitats that they classified as submontane low shrubland (sagebrush–aspen), submontane tall shrubland (Gambel's oak–serviceberry and tamarisk–willow–piñon), submontane forest and woodland (piñon–juniper), montane grassland (grass–aspen), montane tall shrubland (sagebrush–aspen), and montane forest and woodland (Douglas-fir–aspen and grass–spruce–fir).

Jackson and Herder (1997) captured the silver-haired bat in southern Utah in riparian situations (50%) and in ponderosa pine forest (50%). (They also detected this species acoustically in desert shrub habitat.)

In the Grand Staircase–Escalante National Monument of southern Utah, Day and Peterson (1999a) mist-netted *L. noctivagans* in riparian situations (80%) and in piñon–juniper habitat (20%). Day and Peterson (1999b) in southwestern Utah captured this species in riparian habitat (86%) and in a sagebrush–grass opening within mixed forest (14%).

The range of elevations that have been reported for *L. noctivagans* in Utah is "about 780 m, 2500 ft" (Pritchett no date) to 9,760 ft (Lengas 1994b).

Conservation

This was 1 of the bat species that showed an increase in pesticide residues in its tissues after spraying of DDT to control the Douglas-fir tussock moth in forests of northeastern Oregon (Henny et al. 1982).

Kunz (1982) wrote of *L. noctivagans*: "Assuming that tree-roosting is the preferred habit, extensive deforestation and forest management practices over the last two centuries may have reduced the roosting sites available."

Other Comments

Although Mollhagen and Bogan (1997) reported that in their Henry Mountains study all 71 individuals of *L. noctivagans* that they captured were males and noted that "females of this species appear to summer in the east", there are reports, including summer records, of females of this species from Utah. All 3 of the specimens of *L. noctivagans* that Jensen (1965) had from Rich County were females. However, only 1 of the 57 silver-haired bats captured by Lengas (1994b) in the Ashley National Forest of northern Utah was an adult female, the rest being males, and of 15 individuals of *L. noctivagans* that Day and Peterson (1999a) captured in the Grand Staircase–Escalante National Monument of southern Utah, only 1 was a female—a subadult captured in August.

Summary

- Utah subspecies: none
- Utah distribution: all
- Utah wintering habits: presumed to migrate, but known to remain in winter, based on a mid-December record in sw.
- Utah abundance: common

- Utah habitats: lowland riparian and desert shrub to montane forest; also urban areas
- Utah elevational range: -2,500 to 9,760 ft

Pipistrellus hesperus (H. Allen, 1864)
western pipistrelle

Taxonomy

The subspecies of the western pipistrelle that occurs in Utah is the type race, *Pipistrellus hesperus hesperus* (see Findley and Traut 1970, Hall 1981).

Shuster (1957) reported:

> Skulls of a series of twenty animals [*P. hesperus*] from San Juan County ... are distinguishable in almost every case, on the basis of rostral shape, from those of animals from other parts of the state. In the skulls from animals from San Juan County, the lateral margins of the rostrum (supraorbital ridges) are nearly parallel, whereas in those from other parts of the state, the lateral margins are more divergent .... Differences in skull measurements of several populations were analyzed statistically. At plus or minus two standard errors all of the differences in sample means were non-significant, but due to the small sample sizes employed true differences might not have been detected. For almost all skull measurements taken, skulls from animals from Washington County averaged the largest and those from San Juan County, the smallest. Forearm measurements, on the other hand, exhibited the opposite trend, with specimens from San Juan county averaging the largest and those from Washington County the smallest. ... Coloration in these bats also varies geographically, animals from Tooele County being grayer and those from San Juan County being browner .... Animals from eastern San Juan County appear to constitute a readily distinguishable deme. Further study of larger and more representative series may possibly warrant raising of this complex to subspecific status.

However, Findley and Traut (1970) examined 2,510 specimens from throughout the range of the western pipistrelle, including many from various parts of Utah, and recognized only 2 races, 1 east and 1 west of the continental divide. They did note that "'dark colored populations, currently unrecognized nomenclaturally, occur near Salt Lake [and elsewhere]" but that "[c]olor alone will not allow allocation of specimens to the previously described races", which they placed in synonymy with the 2 that they recognized.

Barbour and Davis (1969) commented: "There is some question whether our two pipistrelles [i.e., the 2 American species] should be considered as belonging to the same genus. The bacula are strikingly different (Hamilton, 1949). Also *P. hesperus* has 46 chromosomes, whereas *Pipistrellus subflavus* [the eastern pipistrelle] has 56 (Baker and Patten [*sic*], 1967). Such differences are not found within other genera of bats." These 2 species are placed in different subgenera (see Koopman 1993), each

of which has been treated by at least 1 author as a distinct genus, although such generic arrangements have not gained acceptance by most bat taxonomists and other mammalogists. The subgenus *Hypsugo*, which contains the western pipistrelle, has been regarded as a full genus, and even the subgenus *Perimyotis*, to which the eastern pipistrelle belongs, has been accorded generic status by at least 1 author (for references and discussion, see Koopman 1993). Although Koopman (1993) recognized *Hypsugo* or *Perimyotis* as subgenera, Koopman (1994) did not recognize these taxa, even as subgenera.

Status in Utah

Distribution

The western pipistrelle occurs nearly throughout Utah. It is uncertain whether this bat is present in the extreme north-central and northwestern parts of Utah. Records of its occurrence also are lacking from the Uinta Mountains, the Wasatch Mountains, and from most of the mountains of the central part of the state (the Central High Plateaus).

Durrant (1952) mapped *P. hesperus* as occurring mostly in the southern half of Utah, stating its range as "[s]outhern Utah and western Utah as far north as far north as Tooele County." Durrant et al. (1955) reported *P. hesperus* in Weber County, which extended the known Utah range of this species, and they wrote: "This pipistrelle probably inhabits all of northern and northwestern Utah in suitable habitats. This probability is supported by Davis' (1939:120) report of a specimen from Salmon Creek, eight miles west of Rogerson, Twin Falls County, Idaho."

Shuster (1957) added new Utah localities to those known by Durrant (1952) and wrote that the western pipistrelle is "[k]nown from all but extreme northwestern and northeastern corners of state and is probably state-wide in distribution."

Durrant and Dean (1960) added a locality for *P. hesperus* in Daggett County near the Wyoming border, thus confirming the presence of this species in extreme northeastern Utah. The Daggett County record also suggests that *P. hesperus* occurs in Wyoming, a state from which it has not yet been reported (e.g., see Long 1965, Bogan and Cryan 2000) although it has been speculated to occur in southwestern Wyoming (Bogan and Cryan 2000).

Barbour and Davis (1969) included almost all of Utah within the range of *P. hesperus*, the northwest corner of the state being the largest area excluded from their mapped distribution. Hasenyager (1980) added further localities but reiterated Shuster's (1957) thoughts about the Utah range of *P. hesperus*, stating: "The distribution of the

western pipistrelle in Utah is probably statewide, but there is no documentation of specimens from extreme northwestern or northeastern Utah." This statement, however, contradicts Hasenyager's (1980) own list of known occurrences of *P. hesperus* in Utah, which includes the Daggett County locality record originally reported by Durrant and Dean (1960) that demonstrated the presence of the species in extreme northeastern Utah.

Hall (1981) produced the most conservative map for *P. hesperus* since that of Durrant (1952); he excluded much of the West Desert, the northwest corner, and all of the northern boundary of Utah (the Idaho and Wyoming borders). Hall (1981) apparently was not aware of work that showed that the western pipistrelle occurs in Daggett County not far from the Wyoming line in extreme northeastern Utah (Durrant and Dean 1960, Reynolds 1966, Hasenyager 1980).

Ports and Bradley (1996) documented the occurrence of this species in east-central and northeastern Nevada, filling a supposed hiatus in the distribution of this bat (e.g., see Barbour and Davis 1969, Hall 1981) and further strengthening the suggestion made earlier by Durrant et al. (1955) that *P. hesperus* probably occurs throughout northwestern Utah.

Wintering Habits

The western pipistrelle is presumed to hibernate in Utah, and it is known to be active, at least intermittently, during winter in extreme southwestern Utah, even at freezing temperatures.

Hardy (1941) reported: "[O]n January 29, 1940, one [*P. hesperus*] was shot from the air as it fluttered with others ... south of St. George. The temperature was 47EF. at dusk. These bats may occasionally be seen in the Lower Sonoran Zone on warm evenings in winter. Usually they seem to hibernate in cracks and crevices of ledges, but April 5, 1939, one was taken from beneath a rock about a foot in diameter. A large chuckwalla lizard (*Sauromalus obesus*) was beneath the same rock on this warm spring day."

Twente (1960), discussing winter habits, particularly hibernation, of bats in Utah, noted that *P. hesperus* has been reported to hibernate in Nevada. Although Twente (1960) cited Hardy's (1941) work, he seemed to be unaware of Hardy's winter and spring observations (quoted above) concerning the western pipistrelle in Utah.

Stock (1965), too, cited Hardy (1941) but made no mention of Hardy's observations of this bat in Washington County. Stock (1965) declared: "No records of hibernating individuals are available from the study area [i.e., Washington County] but Neil Jensen

collected several specimens from Gould's Ranch, in December, as they flew above a small pond at mid-day. This indicates hibernation and sporadic feeding during winter months at the lower elevations of the study area."

Ruffner et al. (1979) mist-netted 40 western pipistrelles in December, January, and February in extreme southern Washington County near the Arizona boundary. Of these, 29 were active when air temperatures ranged from –4 to 4 EC at the time of capture, and 9 were active at ambient temperatures of 0 to 6 EC; temperatures were not recorded for the captures of the remaining 2 individuals. Poché (1981) also mentioned mist-netting 55 *P. hesperus* in extreme southern Washington County in winter at the same locality as that reported by Ruffner et al. (1979) and probably including the 40 individuals reported earlier by them. The western pipistrelle is the smallest bat species that occurs in Utah (and America); it is remarkable that so small a bat is capable of activity at temperatures near and even below freezing.

Abundance

The western pipistrelle is abundant in Utah.

Hardy (1941) examined 204 Utah bat specimens representing 15 species; 24 (12%) of these specimens were *P. hesperus*, which was the 4th most abundant bat.

Durrant (1952) examined 182 bat specimens from Utah, of which 53 (29%) were the western pipistrelle. It was the most abundant of the 14 bat species (actually 15, correcting for a misidentification) for which he saw Utah specimens.

Of the 372 Utah bat specimens, of 15 species, examined by Shuster (1957), 76 (20%) were *P. hesperus*, which was the most numerous of all species in her study.

Ranck (1961) regarded *P. hesperus* as the most abundant bat in southern Uintah County and northern Grand County. Similarly, Stock (1965) considered *P. hesperus* to be "the commonest kind of bat" in Washington County.

Reynolds (1966) opined: "Since the study area [Daggett County] is located at the northern limits of their range, the few members of this species [*P. hesperus*] that occur here, are probably summer migrants, that follow up the Green River through its precipitous canyons."

Hasenyager (1980) compiled records of about 178 individuals of the western pipistrelle in Utah. It represented 15% of all his Utah bat records and was the 2nd most abundant of the 18 bat species in his Utah review.

Of 264 or 265 bats mist-netted by Pritchett (no date) and co-workers in southern Washington County, 38 or 39 (14 or 15%) were *P. hesperus*, which was the 2nd most abundant bat that they caught.

Lengas (1994b) mist-netted 220 bats of 9 species in the Ashley National Forest of northern Utah, in and near the Uinta Mountains, but none of these bats was *P. hesperus*. Although the elevations of the 14 sites that Lengas (1994b) netted were moderately high (5,413 to 9,760 ft, mean = 7,732 ft), most of the locations were within the elevational range for this species known in Utah based on captures, and all were within the elevational range of reported acoustic detection of this species in Utah.

Of 157 bats captured in or near the Dugway Proving Ground in Tooele County, 36 (23%) were the western pipistrelle, which was the 2nd most abundant of the 10 bat species that were caught (Ageiss 1996).

Of 572 bats mist-netted in the Henry Mountains area of southern Utah by Mollhagen and Bogan (1997), 64 (11%) were *P. hesperus*. Of the 15 bat species that they captured, it was the 5th most common.

Of 609 bats captured and identified by Jackson and Herder (1997) in southern Utah, 259 (42%) were the western pipistrelle. This species was the most abundant of the 16 bat species that they caught, being more than 3 times as numerous as the 2nd most abundant bat.

Day and Peterson (1999a) captured 640 bats in the Grand Staircase–Escalante National Monument of southern Utah, of which 206 (32%) were *P. hesperus*; it was the most abundant of the 13 kinds (13 or 14 species) of bats that they captured, being nearly twice as numerous in their study as the 2nd most common "kind" of bat, which they considered to be a composite of 2 (or possibly more) difficult-to-distinguish species of *Myotis*.

Day and Peterson (1999b) did not capture *P. hesperus* at any of their 15 sites in southwestern Utah even though they caught 179 bats of 10 or 11 species.

Habitat

The western pipistrelle is best known in Utah from lower elevation habitats such as lowland riparian and desert shrub, but it also utilizes sagebrush, piñon–juniper, and piñon–juniper–sagebrush associations to a lesser extent and even some montane habitats such as mountain brush and mountain meadow. It also has been collected in

Utah near ranch buildings and in farmland. *P. hesperus* has been found in Utah roosting during the day under rocks.

Hardy (1941) mentioned a western pipistrelle that was shot over a "swamp" (presumably actually a marsh) in southwestern Utah, another that was collected from under a rock about a foot in diameter, and yet another from the hall of a college building. Stanford (1931) collected an individual of this species as it was flying near a ranch house and corrals in southern Utah.

Ranck (1961), writing of *P. hesperus* in southern Uintah County and northern Grand County, commented: "These bats were observed on several occasions flying erratically along the margins of precipitous sandstone cliffs and other rocky abutments. ... They appear to be restricted to be restricted to the more arid sectors of the study area, and were rarely observed at elevations above 7,500 feet."

Musser (1961) observed bats in Sevier County that were "flying between the high banks of an irrigation canal. The canal was lined on each bank with high vegetation .... The bats swooped down into the confines of the canal banks, coursed along just above the surface of the water for a considerable distance, and then flew upward and over the adjacent cottonwood trees." He collected 3 *P. hesperus* at this locality and considered this to be the species that he had observed there.

Stock (1965), discussing *P. hesperus* in Washington County, wrote: "I found single individuals under rocks and flaking sections of sandstone, while searching for chuckwalla lizards. In nearly every case, the amount of droppings under the rocks indicated residency of at least a few weeks." The discovery of *P. hesperus* under rocks in the Mojave Desert of Utah by Hardy (1941) and by Stock (1965) may support, in part, a hypothesis proposed later by Barbour and Davis (1969), who apparently were unaware of these earlier works and wrote:

> Over vast areas of flat desert covered almost exclusively with creosote bush (*Larrea*) *P. hesperus* may be the only bat. ... We have seen them appear over the desert in early evening 20 miles or more from the nearest rocky outcrop and nearly as far from any tree or building. Since in captivity these tiny bats desiccate and quickly perish during the day in the desert if not kept moist, it is unlikely that any could survive the day above ground in the desert flats. A reasonable explanation is that they may occupy the burrows of kangaroo rats .... We have no evidence to support this theory, but it deserves investigation. The piles of rocks used to anchor the sand at the bases of highway and railroad bridges across dry arroyos afford another possible retreat in some areas. The bridge timbers themselves give diurnal shelter to some hardy species [of bats] ..., but probably the tiny *P. hesperus* could not survive there.

Armstrong (1974) mist-netted *P. hesperus* in southeastern Utah at a spring in a mesic

community surrounded by uplands dominated by ricegrass and snakeweed and piñon–juniper woodland.

Pritchett (no date) and co-workers mist-netted the western pipistrelle at 3 sites in warm desert shrub communities (100%) in southern Washington County in1991; riparian habitat may have been present at the actual netting sites, within the desert shrub situations, but this was not specified in Pritchett's (no date) report.

In southern Utah, Jackson and Herder (1997) captured the western pipistrelle in riparian (36%), desert shrub (47%), and piñon–juniper (1%) habitats, and at 2 sites for which they did not specify the habitat (16%). (In addition to the habitats where they caught this species, they reported *P. hesperus* based on ultrasonic detection at 1 site in ponderosa pine forest; however, the actual habitat at that site is spruce–fir forest.)

In the Grand Staircase–Escalante National Monument of southern Utah, Day and Peterson (1999a) caught *P. hesperus* in riparian (45%), desert shrub (42%), sagebrush (1%), piñon–juniper–sagebrush (2%), piñon–juniper (4%), mountain brush (5%), and mountain meadow (0.5%) habitats.

The range of reported elevations at which the western pipistrelle has been captured in Utah is 2,600 ft (Stock 1965) to 8,710 ft (Mollhagen and Bogan 1997). Shuster (1957) reported that she had examined 6 specimens of *P. hesperus* from a locality at 2,300 ft elevation in Washington County, but Stock (1965) examined 6 specimens of this species from exactly the same locality, which he placed at 2,600 ft elevation; topographic maps show that the elevation stated by Stock (1965) is correct. Pritchett (no date) also reported capture of the western pipistrelle at a locality, only generally defined, where the "elevation averaged about ... 2500 ft." (Jackson and Herder [1997] reported that they detected *P. hesperus* acoustically in southern Utah at sites that exceed the reported elevational range of captures of this species in the state, their lowest site of acoustic detection of the species being 2,400 ft and their highest being 10,560 ft elevation. This highest site is much higher than the maximum reported elevation of capture of *P. hesperus* in the state, and confirmation based on capture of *P. hesperus* at such a high elevation in Utah would be desirable.)

Conservation

The western pipistrelle seems secure in Utah, being this state's most abundant bat. However, general threats to bats, such as pesticides and habitat loss, could affect this species.

Summary

- Taxonomy: generic name possibly could become *Hypsugo*
- Utah subspecies: *P. h. hesperus*
- Utah distribution: nearly all, but no records from extreme n.-c. and nw. and from Uinta Mtns., Wasatch Mtns., and mtns. of Central High Plateaus
- Utah wintering habits: known to be active in winter in sw.; presumed to hibernate, but no records
- Utah abundance: extremely abundant
- Utah habitats: especially lowland riparian and desert shrub, but also sagebrush, juniper, piñon, mountain brush, mountain meadow; ranch and farmland
- Utah diurnal roosts: under rocks in sw.
- Utah elevational range: #2,500 to $8,710 ft

Eptesicus fuscus (Palisot de Beauvois, 1796)
big brown bat

Taxonomy

The race of the big brown bat that occurs in Utah is *Eptesicus fuscus pallidus* (Hall 1981, Burnett 1983, Kurta and Baker 1990).

Long (1940) assigned Utah bats of this species to the type race, *Eptesicus fuscus fuscus*, but without explanation. Hardy (1941) commented: "There seems to be some uncertainty regarding which race, *fuscus* or *pallidus*, is in Utah. ... All of the material examined in this study seems referable to the subspecies *pallidus*."

Musser (1961) commented:

> [S]pecimens [of *E. fuscus*] from the Tushar and Pavant highlands possess several striking cranial differences from [big brown] bats taken in Washington County in southwestern Utah. Compared with bats of comparable age and sex from Washington County, those from the study area possess longer, more massive skulls, more widely flaring zygomatic arches and generally more inflated braincases.

He also noted some minor differences in color between the 2 populations. Musser (1961) assigned his specimens from the Tushar Mountains and the Pavant Range to the race *E. f. pallidus* but did not offer an opinion concerning the subspecific identity of Washington County specimens. Stock (1965) followed others (Presnall 1938, Hardy 1941, Durrant 1952, and Shuster 1957) in assigning specimens of *E. fuscus* from Washington County to *E. f. pallidus* and declared: "... I have found, as did Shuster (1957:41), that little variation in cranial measurements exists between members of different populations of this species throughout the state." Shuster (1957) had written: "... [S]kull measurements of members of four populations [of *E. fuscus*] within the state are amazingly constant."

Koopman (1989, 1994) has suggested that *E. fuscus* of the New World is conspecific with an Old World species, the serotine, and should bear the scientific name applied to that species, which has priority. Although Koopman (1993) listed *E. fuscus* as a species, he commented that it is "[c]losely similar to *serotinus* with which it may be conspecific." Koopman (1994), however, did nor recognize *E. fuscus* as a species, and, writing of *E serotinus*, he commented:

> This species shows considerable diversity over its extensive range and New World

> representatives have usually been separated as *E. fuscus*, but a clear cut separation between the two has not been demonstrated.

Bogan (1999) commented: "Koopman (1989) has provided convincing reasons for recognizing *E. fuscus* as part of *E. serotinus* of the Old World. Until someone demonstrates a clear-cut separation of the two it seems prudent to use *serotinus* for the New World representatives." Bogan and Cryan (2000) also have summarized this nomenclatural question:

> We note here that Koopman (1989, 1994, but not Koopman, 1993) suggested that North American bats of this species [*Eptesicus fuscus*] should be known by the name *E. serotinus*, rather than the more traditional *E. fuscus*. We further note that most authors (e.g., Jones et al., 1997) continue to use *E. fuscus* without acknowledging the alternative suggested by Koopman (1989, 1994).

Status in Utah

Distribution

The big brown bat occurs throughout Utah.

All modern authors have considered the big brown bat to occur throughout Utah (e.g., Barnes 1927, Durrant, 1952, Shuster 1957, Barbour and Davis 1969, Hasenyager 1980, Hall 1981, Kurta and Baker 1990). Hasenyager (1980) compiled records of *E. fuscus* from 22 Utah counties, which was more than for any other species of bat in Utah. He listed 64 localities for this species in Utah; only 1 other bat species was represented by as great a number of Utah localities in his study (Hasenyager 1980).

Wintering Habits

The big brown bat is known to hibernate in mines and caves in Utah, there being hibernation records from the extreme southwestern part of the state as well as from extreme north-central Utah.

Hardy (1941) reported "two specimens [of *E. fuscus*] taken at the Apex Mine in Washington County on March 9, 1940, ... [which were] hibernating there at that time. Both were males and each was hanging singly."

Although Twente (1960) cited Hardy (1941), he made no mention of the hibernation record quoted here and incorrectly asserted that big brown bats "are unreported as hibernators in Utah in the previous literature" and that "[s]ome species which

presumably hibernate (... *Eptesicus fuscus*) have been found to inhabit buildings in Utah during the summer but none have been found in buildings or elsewhere reported from Utah in wintertime." From his own new work Twente (1960) reported: "Five *Eptesicus fuscus* were ... found in a crack in the wall of Logan cave in February ...", and "The five *Eptesicus fuscus* which were found in a crack in the wall in Logan Cave, a typical hibernaculum for this genus, had body temperatures of about 13E C. Perhaps this bat could survive at this [high] temperature because of its larger size."

Stock (1965), too, cited Hardy (1941) but in his account for *E. fuscus* incorrectly stated: "No hibernating individuals have been reported from the study area [Washington County]."

Although Musser (1961) reported that 6 big brown bats that he found in an attic of a ruined residence in Holden were torpid, "wedged in the space between the central supporting beam and the roof", he did not suggest that they were hibernating, and the late date, 27 April, argues against hibernation.

Abundance

The big brown bat is abundant in Utah.

Of 204 Utah bat specimens of 15 species examined by Hardy (1941), 39 (19%) were *E. fuscus*, which was the most numerous of all bats in his study.

Durrant (1952) examined 182 bat specimens from Utah, representing 14 species (actually 15 species after re-identification of 1 specimen); 32 (18%) of these specimens were big brown bats, and this species was the 2nd most abundant bat.

Among the 372 Utah bat specimens of 15 species examined by Shuster (1957), 61 (16%) were *E. fuscus*, and it ranked 2nd in abundance.

Hansen (1951) called *E. fuscus* "the most commonly observed bat" in the Mt. Nebo area of Utah County and in the Deep Creek Mountains of Juab and Tooele counties. Ranck (1961) wrote that the big brown bat "is probably the commonest of the large bats" in the Uintah Basin and the East Tavaputs Plateau. Stock (1965) considered *E. fuscus* to be common in Washington County.

Hasenyager (1980) compiled Utah records of 197 individuals of *E. fuscus*. This was the most numerous of all the 18 bat species in his Utah study, representing 16% of his records for individuals.

None of the 157 bats of 10 species captured in and near Dugway Proving Ground in Tooele County was the big brown bat (Ageiss 1996)

Pritchett (no date) and co-workers mist-netted 264 or 265 bats of 10 species in southern Washington County in1991; 18 (7%) of these were *E. fuscus*, which was 5th in abundance of the bat species that they caught.

Lengas (1994b) mist-netted 7 big brown bats in the Ashley National Forest of northern Utah; this species represented 3% of the 220 bats that he caught and was 5th in abundance of the 9 species captured.

The big brown bat was the most abundant of the 15 bat species mist-netted by Mollhagen and Bogan (1997) in the Henry Mountains area of southern Utah; 94 (16%) of the 572 bats that they caught were this species.

Jackson and Herder (1997) captured 77 big brown bats in their southern Utah bat survey; this species represented 13% of the 609 bats that they caught and identified, and it was the 2nd most abundant of the 16 species captured in their study.

E. fuscus was the 4th most numerous of the 13 kinds of bats (13 or 14 species) mist-netted by Day and Peterson (1999a) in the Grand Staircase–Escalante National Monument of southern Utah; 64 (10%) of the 640 bats that they mist-netted were this species.

Day and Peterson (1999b) captured 18 big brown bats in southwestern Utah. Although they stated that "*E. fuscus* was one of the two most common and widespread species in this survey", their data show that it was neither. It was the 4th most common of the 179 bats of 10 kinds (10 or 11 species) that they caught, and it was one of the 3 most widespread based on the number of sampling sites where it was captured.

Habitat

In Utah the big brown bat is known from a variety of habitats: lowland riparian, desert shrub, sagebrush–grass, sagebrush–grass–piñon–juniper, juniper–sagebrush, juniper, piñon–juniper, piñon–juniper–sagebrush, sagebrush–rabbitbrush, sagebrush–greasewood near piñon–juniper, aspen–coniferous forest, ponderosa pine forest, mountain brush, mountain meadow, montane tall shrubland (sagebrush–aspen), montane grassland (grass–aspen), subalpine low shrubland (sagebrush–aspen), and montane forest and woodland (grass–spruce–aspen). It also has been found in Utah in cities and towns and in farmland. Utah maternity colonies are often in attics of buildings. A diurnal roost was in an abandoned mine.

Stanford (1931) shot big brown bats in 2 Utah towns (Salina and Logan).

Long (1940) reported 2 maternity colonies of *E. fuscus* in buildings in Utah, in both cases the roosts being shared with *Tadarida brasiliensis*. The first was in one of the ruined barracks at old Fort Beaver, where "[t]he projecting edges of the roof had been boarded up on both sides of the rafters, leaving a dark space inside." Two days later Long found that the colony had moved, and "a group of about 25 young and a few adults was found clinging to the chimney and hiding in cracks in the attic of this same building. The entire colony had moved from the eaves, where first seen, into the attic. Every adult bat examined was a female." The second maternity colony was "in the attic of an occupied house" and "all of the big brown bats were either females or young", most of which "were clinging to the chimney or the joists."

Hardy (1941) reported a Utah maternity colony of *E. fuscus* in "the attic of a building that is still used as a human dwelling place. Only females and their young were found in the large clusters examined." He reported another Utah colony of *E. fuscus* (probably a maternity colony) in "a narrow crack between a rock wall of a house and the framework of the attached wooden porch." Hardy (1941) also mentioned specimens of *E. fuscus* "collected ... in flight over an alfalfa field" in southwestern Utah.

Hansen (1951) collected a big brown bat "high above a streamside just before dusk" on Mount Nebo and 2 "over a meadow" in the Deep Creek Mountains.

Musser (1961) found roosts of *E. fuscus* in the attics of 2 ruined buildings in Holden; 1 of these was utilized by 6 adult females when first found and by 35 adult females, but none with embryos or young, when visited later. He also found a big brown bat in the attic of the Richfield Courthouse. Musser (1961) also reported that "a big brown bat was shot at dusk as it flew adjacent to cottonwoods" and another was collected at dusk as it flew with others over a cultivated field near Beaver.

Stock (1965) found several colonies of *E. fuscus* in the attics of older buildings in the vicinity of St. George and noted that these bats were especially common around towns, where he saw them catching insects attracted to street lights at night, and farm buildings. He also shot them over desert waterholes and observed them in the Beaver Dam Wash "flying about the tall cottonwoods as they presumably forage for caterpillers [*sic*] which infest the trees in spring."

Easterla (1965) collected *E. fuscus* in Garfield County in a treeless, rolling area of sagebrush and rabbitbrush a few miles from montane ponderosa pine forest.

Armstrong (1974) mist-netted a big brown bat at a spring in the bed of a canyon in San Juan County. Although the vegetation around the spring was typical of wet sites

(horsetail, cattail, bulrushes, willows, grasses, and sweet-clover), the surrounding uplands were open flats sparsely covered with ricegrass and snakeweed and rocky areas supporting an open piñon–juniper woodland.

Pritchett (no date) and co-workers captured the big brown bat in southern Washington County at 3 sites, all in warm desert shrub, although some of these were probably in riparian settings within the desert shrub habitat.

In the Ashley National Forest of northern Utah, Lengas (1994b) mist-netted *E. fuscus* in riparian (aspen, willow, some Douglas-fir) (14%), sagebrush–greasewood–piñon–juniper (71%), and aspen–coniferous forest habitats (14%). In Grand County, Lengas (1997d) found a big brown bat on 9 October "roosting in a drill hole" at the back of an abandoned mine, 34 m from the portal, where the temperature was 15.6 EC and the relative humidity was 64%.

Foster et al. (1997) captured the big brown bat in southern Utah in montane grassland (grass–quaking aspen), montane forest and woodland (grass–Engelmann spruce–quaking aspen), montane tall shrubland (big sagebrush–quaking aspen), and subalpine low shrubland (black sagebrush–quaking aspen).

Jackson and Herder (1997) captured *E. fuscus* in southern Utah in riparian (40%), desert shrub (42%), juniper–sagebrush (3%), juniper (6%), piñon–juniper (4%), and ponderosa pine (1%) habitats and at 1 site for which they did not indicate a habitat type (4%).

In Day and Peterson's (1999a) bat study of the Grand Staircase–Escalante National Monument in southern Utah, the big brown bat was mist-netted in riparian (36%), desert shrub (16%), piñon–juniper–sagebrush (22%), piñon–juniper (13%), mountain brush (5%), and mountain meadow (9%) habitats.

Day and Peterson (1999b) caught the big brown bat in southwestern Utah in riparian (78%), sagebrush–grass (6%), sagebrush–grass–piñon–juniper (6%), and ponderosa pine (11%) situations.

The lowest reported elevation at which *E. fuscus* has been captured in Utah is that of Pritchett (no date) who indicated that in 1 of the areas where this species was caught the "elevation averaged about … 2500 ft." The highest elevation of capture in Utah that has been reported is 9,200 ft (Foster et al. 1997). (Jackson and Herder [1997], however, reported that they detected the big brown bat acoustically at elevational extremes of 2,400 ft and 10,560 ft in Utah.)

Conservation

Musser (1961) reported that in the attic of a ruined storage building in Holden (eastern Millard County) he found remains of the big brown bat:

> The skulls of two mummified *E. fuscus* were badly crushed, as if death was caused by heavy blows. Several young boys who lived in town told me that they chased bats around the attic many times, sometimes catching them, other times using clubs to kill the animals.

Musser (1961) also mentioned that in the attic of a ruined residence across the street opposite the storage building in Holden he found 6 adult female *E. fuscus*, all of which he collected and preserved, and, when he returned a month later, he found "35 adult females of *E. fuscus*" and again "[a]ll were collected and prepared as specimens. ... During subsequent visits to the attic ..., no bats were found."

Barbour and Davis (1969) reviewed information concerning the sensitivity of big brown bats to chlorinated pesticides such as DDT. Relative to other mammals, *E. fuscus* is extremely sensitive to DDT, but much more so in spring than in fall, making these bats "most susceptible to poisoning when they emerge from hibernation with fat reserves depleted in the spring."

Black (1976) reported that an American kestrel made repeated aerial attempts to capture a big brown bat that he released in the afternoon in New Mexico, and the falcon was finally successful. Such results have come to be well known, and even when daytime release of bats is purposeful, as it was in this case, "in the hope of obtaining data on location of roosting sites and orientation behavior", it should be avoided. Moreover, it is questionable whether bats released during the day exhibit normal roosting or orientation behavior, perhaps taking refuge in places that they would not otherwise use for diurnal roosts in their desperation to avoid possible predation.

The big brown bat was 1 of the species that showed an increase in pesticide residues in its tissues after spraying of DDT to control the Douglas-fir tussock moth in forests of northeastern Oregon (Henny et al. 1982).

Kurta and Baker (1990) reviewed literature concerning the effects of synthetic toxins such as pesticides on *E. fuscus*, writing: "Man-made chemicals (DDT, DDE, PCB, dieldrin, methyl parathion) are concentrated in milk, embryos, and adult tissues and may cause death ...."

Summary

- Taxonomy: correct name may be *Eptesicus serotinus*, the serotine
- Utah subspecies: 1, *E. f. pallidus*
- Utah distribution: all
- Utah wintering habits: known to hibernate in caves and mines in n. and sw.
- Utah abundance: abundant
- Utah maternity colonies: in buildings (e.g., attics)
- Utah habitats: many, from desert shrub to montane forest; also cities, towns, and farmland
- Utah diurnal roosts: a mine
- Utah elevational range: #2,500 to $8,600 ft

Euderma maculatum (J. A. Allen, 1891)
spotted bat

Taxonomy

The spotted bat is monotypic (e.g., Watkins 1977, Hall 1981). Best (1988) studied morphological variation of *E. maculatum* throughout its range and found some significant morphometric differences between populations but did not suggest that subspecific designations were warranted.

Status in Utah

Distribution

The spotted bat probably occurs throughout Utah, as it has been mapped hypothetically by Watkins (1977) and Hall (1981), but records from extreme northern and almost all of western Utah (except for the southwest corner) are not known.

Barbour and Davis (1969) conservatively mapped the distribution of *E. maculatum* as including southernmost Utah and a disjunct occurrence in the Salt Lake City area, and Hasenyager (1980) thought that "the range of the spotted bat in Utah could incorporate the southern third of the state and central portions of the west desert where suitable roosts exist, excluding the higher portions of the central mountain range."

Although records of *E. maculatum* are still lacking from large parts of Utah, the fact that this species is known from all states bordering Utah supports the belief that it is of statewide occurrence, and this belief is strengthened even more by records of this bat from most of the geographic extremes of the state—the southwestern (Poché and Bailie 1974), southeastern (Benson 1954), and northeastern (Lengas 1994b, Storz 1995) corners, as well as from north-central (Durrant 1935) Utah. Notable, however, is the absence of records of this species from most of western and northern Utah.

Wintering Habits

There is evidence of both hibernation and winter activity of the spotted bat in at least southwestern Utah.

The first winter record of *E. maculatum*, and [apparently] the only hibernation record for this species, is from Utah. Hardy (1941) documented this record:

> Bernell McAllister of the Soil Conservation service at Saint George reports that in February, 1930, he collected four big-eared "black and white pinto" bats in Crocodile Cave, four miles north of Kanab in Kane County. He observed that they were hibernating on the walls of the cave above the large pool of water. They hung by the thumb with the head up and not head downward as do other bat, according to Mr. McAllister. Subsequent visits failed to reveal others.

Twente (1960), despite the fact that he cited Hardy (1941), made no mention of this Utah hibernation record and wrote: "No reports have been located regarding the wintering habits of the apparently rare *Euderma maculatum* and of [4 species of *Myotis*] in the temperate parts of their geographical ranges."

Ruffner et al. (1979) showed that *E. maculatum* also is active during winter in extreme southwestern Utah. They captured 7 active *E. maculatum* in January and February in extreme southern Washington County, near the Arizona border. Air temperatures at the times of capture of 6 of these spotted bats in January ranged from –5 to 4 EC. Poché (1981) also reported winter activity of spotted bats in extreme southern Washington County and mentioned captures of active individuals of this species in January and February; 1 was mist-netted on 15 January when the ambient temperature was –5 EC; 2 others were netted on 6 and 8 January, when the "mean" ambient temperature was –3 EC.

Abundance

The spotted bat appears to be rare in Utah. However, because of the tendency of this species to forage high above the ground (Wai-Ping and Fenton 1989) and thus not to be readily captured in mist nets, it may be more common in Utah than records suggest.

Durrant (1952) examined 182 Utah bat specimens of 14 species (15, if corrected for a later re-identification), but only 1 (0.5%) was *E. maculatum*, which was either the rarest of the 14 species or was tied as the rarest of the actual 15 species of which he saw Utah specimens.

Of the 372 Utah bat specimens of 15 species examined by Shuster (1957), again only 1 (< 0.02%) was a spotted bat, and this species was the rarest of those of which she looked at specimens.

Although Hasenyager (1980) listed records of *E. maculatum* in Utah that, when added, total 13 plus "many", he summed these records as "9 + ". Regardless of whether one

uses the correct tally or the incorrect total, if the "many" and the " + " are ignored, *E. maculatum* ranked 16th in abundance of the 18 Utah bat species in Hasenyager's (1980) review. However, Hasenyager (1980) almost certainly was aware of Poché's work in progress and clearly knew of the work of Poché and Bailie (1974). Thus, the "many" seems be the 82 *E. maculatum* reported later by Poché (1981) (see below). If so, Hasenyager's total for *E. maculatum* could have been 95, which would have made this species the 5th most common bat in his Utah review.

Ruffner et al. (1979) captured 7 spotted bats in southwestern Utah. Poché (1981) caught 82 *E. maculatum* near the Utah–Arizona boundary, but his map of the study area shows that 2 of his 5 netting sites were actually in Arizona, and it is unclear how many spotted bats were actually captured in Utah. Also, the 82 individuals reported by Poché (1981) included the 4 reported by Poché and Bailie (1974), the 8 reported by Poche and Ruffner (1975), and probably the 7 reported by Ruffner et al. (1979).

Pritchett (no date) reported the capture of 12 spotted bats among 264 or 265 bats netted in 1991 in southern Washington County; of the 10 bat species caught, *E. maculatum* was 6th in abundance and represented 4.5% of captures.

None of the 220 bats netted by Lengas (1994b) in the Ashley National Forest of northern Utah was *E. maculatum*. (However, he reported that he heard 2 spotted bats during the course of his field work.) Similarly, none of the 157 bats of 10 species captured in or near Dugway Proving Ground in Tooele County was *E. maculatum* (Ageiss 1996).

Only 1 (< 0.2%) of the 572 bats mist-netted by Mollhagen and Bogan (1997) in the Henry Mountains area was *E. maculatum*, which was the rarest of the 15 bat species that they caught.

Jackson and Herder (1997) netted 12 individuals of *E. maculatum* among the 609 bats of 16 species that they captured and identified in southern Utah; the spotted bat represented 2% of their captures and ranked 11th in abundance of the 16 species that they caught.

None of the 640 bats of 13 or 14 species mist-netted by Day and Peterson (1999a) in the Grand Staircase–Escalante National Monument of southern Utah was *E. maculatum*. Similarly, the spotted bat was not among the 179 bats of 10 or 11 species captured by Day and Peterson (1999b) in southwestern Utah.

Habitat

The spotted bat has been captured in Utah in several habitats: lowland riparian habitat

in the desert shrub community, sagebrush–rabbitbrush, ponderosa pine forest, montane grassland (grass–aspen), and montane forest and woodland (grass–spruce–aspen). It has also been occasionally found in or on buildings in Utah towns and cities.

Durrant (1935), in the first report of the spotted bat in Utah, stated that an individual was found under the eaves of a school building in Salt Lake City. Hardy (1941) mentioned a report of an individual of *E. maculatum* that was found on the sleeping porch of a house in southern Utah. Toone (1993) mentioned a verbal report of a spotted bat that was found on a window sill of a house in Cedar City.

Easterla (1965) captured *E. maculatum* in southern Utah in a treeless, rolling area of sagebrush and rabbitbrush "in the Upper Sonoran Life Zone"; ponderosa pine forest was present in mountains 3–4 miles away.

Poché and Bailie (1974) described a site "in the Lower Sonoran Life Zone" near the Arizona border in southwestern Utah where they, and later others (Poché and Ruffner 1975, Poché 1981, Pritchett no date, and Jackson and Herder 1997) captured *E. maculatum*: "Vegetation consists primarily of creosote bush (*Larrea tridentata*), snakeweed (*Gutierrezia microcephala*), blackbrush (*Coleogyne ramosissima*), bursage (*Franseria dumosa*), and scattered *Yucca*. Riparian vegetation in the wash is mainly salt cedar (*Tamarix pentandra*), creosote bush, and desert willow (*Chilopsis linearis*)."

Poche and Ruffner (1975) and Poché (1981) thought that cracks and crevices in cliff walls were important roost sites for *E. maculatum* in extreme southwestern Utah. Their method was to release captured spotted bats, apparently in daylight (explicitly so when time of release was mentioned at all), and to observe the bats as they sought refuge. It is questionable, however, whether their observed results represented natural behavior and not desperation on the part of the bats to find any—and perhaps the closest—hiding places that would provide immediate protection from predators such as diurnal raptors and from inhospitable daytime conditions. Poche and Ruffner (1975) reported that 1 of the spotted bats that they released "had backed underneath [a] fallen rock" about 50 cm in diameter. Concerning another *E. maculatum*, released during daylight, that had landed on a cliff face, they wrote: "After several unsuccessful attempts to locate a crack large enough to crawl into, the *Euderma* appeared to be 'nervous.'" Although they concluded that cracks and crevices are the "natural roost" of the spotted bat in this region, the behavior that they observed cannot be considered natural and whether *E. maculatum* normally uses such sites for roosts cannot be determined from such experiments.

(Storz [1995], working on both sides of the northern part of the Utah–Colorado boundary and using acoustic detection of *E. maculatum*, found "strong evidence that open meadows represent important foraging habitat for *E. maculatum* in this area."

and even seemed to avoid the canopy of cottonwoods and box elders that was present.)

Foster et al. (1997) captured the spotted bat in southern Utah in montane grassland (grasses and quaking aspen) and montane forest and grassland (grasses, Engelmann spruce, and quaking aspen).

Jackson and Herder (1997) captured *E. maculatum* in southern Utah in a riparian situation (77%) (mentioned above, described by Poché and Bailie 1974) and in ponderosa pine forest (23%). (They also detected this species acoustically in desert shrub habitat.)

The range of reported elevations at which *E. maculatum* has been captured in Utah is 2,700 ft (Ruffner et al. 1979) to 9,200 ft (Foster et al. 1997).

Conservation

The spotted bat is one of the most fragile of bats and is easily injured during capture and handling. Working with this species in Texas, Easterla (1973) mentioned a spotted bat that "evidently suffered internal injuries [from being netted] and died by 9:00 AM", and "[o]ther *E. maculatum* evidently injured their wings or ears (as evidenced by blood clots), presumably when they struck the net." He concluded: "Evidently *E. maculatum* is a delicate bat."

E. maculatum has been found in many studies to be a late flier (e.g., Easterla 1973), and continuous monitoring of mist nets is necessary to avoid deaths among captured individuals of this species, particularly from drowning or hypothermia. Drowning occurs when the bat is caught in the lower part of the net, which then sags from the weight of the bat into the water over which the net is set. Death from hypothermia results either from the bat's getting wet (as described above) or simply from exposure and exhaustion, hanging caught in an unattended net on a cold night.

Three reports of *E. maculatum* in Utah (Easterla 1965, Poché 1981, Pritchett no date) have mentioned spotted bats that died. All of these deaths resulted from inattention to mist nets. Describing his work in Utah, Easterla (1965) wrote: "The net was left up all night, net-tending terminating around midnight and the spotted bats were always found when I returned at approximately 7:00 AM. ... Because of their gentle disposition and their fairly small teeth and mouth, it is thought that none escaped by chewing out of the net; this is in sharp contrast to [other bats] which chewed out quickly if left entangled in the net." Of the 4 spotted bats that Easterla collected, "[t]wo were found drowned", 1 in the net and 1 near the net, and 1 of the 2 that were alive when

removed from the net was seriously injured and would have died had it been released. About these injured bats Easterla (1965) commented:

> The spotted bat ... was the only species [of the 9 bat species captured] that ever injured itself when striking a net. The first female captured could not fly because of an injury in the carpal region of the right wing. The second female [which had drowned] had a fresh 1½-inch lengthwise rip in the skin of the back; also, the distal half of the left tragus and the tip of the left ear were missing, evidently from an old wound. The drowned male evidently had struck the net and knocked itself into the water, breaking the right radius and causing a **d**-inch rip in the dorsal region of the neck.

Poché (1981) reported that his mist nets were "monitored throughout the night during warmer periods", but this apparently was not the procedure during his winter netting, for

> On 14 January 1975, a male [spotted] bat died of exposure when it fell into the water after it struck the net near the water's surface. This pool was completely frozen by sunrise (approximately 4 cm thick). The bat was encased in ice and could not be removed until the ice sheet thawed.

This male *E. maculatum* that drowned or died of hypothermia was almost certainly among those reported by Ruffner et al. (1979), who made no mention of this net casualty. Moreover, this was not the only spotted bat that died in the course of Poché's (1981) study, for elsewhere in his report he mentioned: "Five individuals [of *E. maculatum*] ... were found drowned in the water below the nets."

Pritchett (no date), too, reported:

> ... [O]ur mist nets ... were checked at 2100, 2300, 0100, 0300 and 0600 hours. Checking our nets this often allowed us to make certain bats were not injured while in the net. ... [O]ne very low flying spotted bat was caught in the net and drowned.

These are not the only hazards associated with the capture and handling of spotted bats, however. Spotted bats netted and later released during daylight are vulnerable to predation by hawks and falcons (Easterla 1973, Black 1976). In New Mexico, Black (1976) watched bats of 3 species that he released during daylight and that were attacked by American kestrels. One of these was a lactating female *E. maculatum* that he released in mid-afternoon. The bat was easily captured by a kestrel, which carried it to a perch and began to eat it. Black (1976) commented:

> All bats pursued [by kestrels], except *E. maculatum*, altered their flight patterns in a manner suggestive of avoidance behavior .... Having observed *E. maculatum* flying in bright light, I am impressed by how the large, pale membranes and ears

> render this species conspicuous and, therefore, susceptible to predation, perhaps more so than [the other bats]. Furthermore, the large ears of *E. maculatum*, which are held forward in flight, might hinder visual perception of objects approaching from above or behind.

Easterla (1973) reported multiple instances of diurnal raptors (falcons and a hawk) pursuing spotted bats that he released during daytime.

Regardless of how mist nets are used, collecting of spotted bats for specimens ensures their deaths, and the spotted bat is among the most desired of all species by the collectors of mammals.

Fenton et al. (1983) identified pesticides and scientific collecting as the two most important threats to the spotted bat, but they commented: "Of the two threats to *Euderma maculatum*, we consider collection of specimens to be the most important." They were careful to point out that

> [t]o place a moratorium on any efforts to capture spotted bats would preclude some studies that could increase our knowledge about the animal and make possible the preparation of sound management plans. ... Capture is one thing, however, and collection another. We see no reason to sanction the sacrifice of more specimens of *E. maculatum*. We find no burning unanswered systematic questions about this species which are not addressable through access to existing collections. At a recent meeting of bat researchers, a colleague from a large and well-known museum expressed chagrin at the fact that their collections did not include a 'good' *Euderma* specimen. Perhaps this attitude is the most important threat to this mammal.

Biologists using mist nets for bat work should monitor nets continuously, since they may capture *E. maculatum* and since this species is extremely delicate and thus is especially vulnerable to net injury or death while in nets. Biologists who capture *E. maculatum* should release the bats at the proper time (i.e., at night) rather than holding the bats until the next morning and releasing them during daylight, since individuals of this species released during the day frequently fall prey to hawks.

Summary

- Utah subspecies: none
- Utah distribution: probably occurs throughout Utah, but records lacking from w. (except sw.) and extreme n.
- Utah wintering habits: hibernates in caves and is active during winter in sw.
- Utah abundance: rare (but possibly more common than it seems)
- Utah habitats: lowland riparian and desert shrub to montane coniferous forest
- Utah elevational range: 2,700 to 9,200 ft

Idionycteris phyllotis (G. M. Allen, 1916)
Allen's big-eared bat

Taxonomy

Early reports of this bat in Utah (e.g., Black 1970, Armstrong 1974, Poché 1975, Hasenyager 1980) referred to it as *Plecotus phyllotis*, the Mexican big-eared bat, these being the scientific and vernacular names that were formerly applied to the species. The common name Mexican big-eared bat is clearly inappropriate for this species, being a name much more appropriately applied to another species, *Plecotus (Corynorhinus) mexicanus*, which has not yet been detected north of México. In addition to the name Allen's big-eared bat (e.g., Barbour and Davis 1969), 2 other vernacular names, Allen's lappet-browed bat (Hoffmeister 1986) and lappet-eared bat (e.g., Tumlison 1993) are appropriate names that have been applied to *Idionycteris phyllotis*.

Although Frost and Timm (1992) considered *Idionycteris* to be a synonym of *Euderma*, which results in the combination *Euderma phyllote* for Allen's big-eared bat, Tumlison and Douglas (1992) retained *Idionycteris* as a genus distinct from *Euderma*.

Although Koopman (1993) listed Allen's big-eared bat as *Idionycteris phyllotis*, Koopman (1994) returned to the name that had been used earlier, *Plecotus phyllotis*, arranging *Idionycteris* as a subgenus of *Plecotus*.

Genoways and Jones (1967) found some geographic variation within *I. phyllotis* but none that would argue for designation of subspecies. If recognition of subspecies in *Idionycteris phyllotis* is justified, then the race that occurs in Utah is *Idionycteris phyllotis hualapaiensis*, a northern subspecies proposed by Tumlison (1993) based on morphometric differences between it and populations occurring farther south. However, there are reservations concerning the validity of this subspecies, for some authors (Mollhagen and Bogan 1997, Bogan 1999) tentatively continue to treat *I. phyllotis* as monotypic while acknowledging that 2 infraspecific taxa have been proposed by Tumlison (1993).

Examination of the data used by Tumlison (1993) to distinguish the proposed races shows considerable overlap between his 2 nominal subspecies in all characters, including the 4 cranial measurements that were considered by Tumlison to be diagnostic. Clinal variation may also exist in the data, but southernmost (i.e., Mexican) populations resemble northernmost populations very closely in almost all measurements. Tumlison asserted that "[p]opulations of *I. p. phyllotis* from Mexico differ from *I. p. hualapaiensis* in being larger and having proportionately longer auditory

bullae", but his data show that the 2 populations are very similar in most measurements, that auditory bullae are the same (absolute) length in Mexican populations and *I. p. hualapaiensis*, and that auditory bullae in Mexican populations actually are proportionately *shorter* (relative to length of skull) than in *I. p. hualapaiensis*, not longer. The only measurement that showed even moderately strong geographical differences in Tumlison's study was mastoid breadth. Had statistics been applied by Tumlison to his data, it seems unlikely that the differences he perceived would have been significant, except, perhaps, for mastoid breadth. Thus, in almost all respects Tumlison's proposed subspecies appear to be only very weakly differentiated.

Status in Utah

Distribution

Allen's big-eared bat reaches the northern limit of its range in Utah; it occurs throughout the southeastern quarter of the state and in the extreme southwestern corner of Utah.

Barbour and Davis (1969) correctly predicted that this species would be discovered in Utah, and it was first found in the state, in San Juan County, on 12 June 1969 (Black 1970), the same year that their prediction was published.

There are published records of this species from San Juan (Black 1970, Armstrong 1974), Washington (Poché 1975), and Garfield (Mollhagen and Bogan 1977, Foster et al. 1997) counties. Agency reports also document *I. phyllotis* from Grand (Toone 1993), Wayne (Bogan in Pritchett no date), and Kane (Day and Peterson 1999a) counties.

Toone (1993) noted: "O'Farrell (pers. comm.) suggests that this species is slowly extending its range northward." This belief seemingly is based on the pattern seen in reviewing localities and dates of capture of *I. phyllotis* bat in Arizona and Utah. Although the dates mentioned by Toone are not correct, it may be true that northward expansion is occurring, but it is also possible that such a pattern is only an artifact and represents no more than the growing interest and intensified efforts on the part of bat researchers in northern Arizona and southern Utah, particularly on the Colorado Plateau, coupled with more intensive, intelligent, and effective use of mist nets. Hoffmeister (1986) has commented: "If this species [*I. phyllotis*] has only recently moved into Arizona, Nevada, Utah, and New Mexico, it is difficult to account for this. There has been no drastic change in habitat or the sudden availability of more … roosts."

Wintering Habits

Nothing is known regarding the winter habits of Allen's big-eared bat in Utah, nor, apparently, are its winter habits known elsewhere. Summarizing knowledge about *I. phyllotis* throughout its range, Czaplewski (1983) stated that "[s]easonal movements and cold-season whereabouts and activities of the species are unknown."

Abundance

Allen's big-eared bat is rare in Utah. It was the last of the 18 bat species to be discovered in Utah, not having been known to occur in this state until 1969 (Black 1970).

Hasenyager (1980) knew of only 4 individuals of *I. phyllotis* that had been captured in Utah; it was by far the rarest of the 18 bat species and represented only 0.3% of all the bat records in his Utah review.

Pritchett (no date) reported that 2 (< 1%) of 264 or 265 bats netted in southern Washington County in 1991 were *I. phyllotis*; this bat was the rarest of the 10 species that were caught.

Toone (1994) reported that 2 (17%) of the 12 bats that she captured and identified (1 unidentified bat escaped) in southeastern Utah were Allen's big-eared bats.

Mollhagen and Bogan (1997) captured 9 Allen's big-eared bats in the Henry Mountains area; this species represented < 2% of the 572 bats that they caught, and *I. phyllotis* was one of the rarest bats in their study, ranking 12th out of the 14 species that they mist-netted.

Of 609 bats captured and identified by Jackson and Herder (1997) in southern Utah, only 1 individual (0.16%) was Allen's big-eared bat; it tied with 1 other bat as the rarest of the 16 species that they caught.

Among the 640 bats that Day and Peterson (1999a) captured in southern Utah, 16 (2.5%) were *I. phyllotis*; it was 8th in abundance of the 13 kinds (13 or 14 species) of bats that they netted. None of the 179 bats of 10 or 11 species caught by Day and Peterson (1999b) in southwestern Utah was *I. phyllotis*.

Habitat

Despite the seeming rarity of Allen's big-eared bat in Utah, this species has been reported from a moderately wide range of habitats in this state: lowland riparian, desert shrub, sagebrush, piñon–juniper–sagebrush, piñon–juniper, mountain brush, mixed forest (narrowleaf cottonwood–ponderosa pine–piñon–juniper–oak), and submontane tall shrubland (tamarisk–willow–piñon).

Black (1970) reported the habitat where the first Utah specimen of *I. phyllotis* was taken as piñon–juniper woodland.

Armstrong (1974) described the site of capture of 2 more Allen's big-eared bats in southeastern Utah:

> The vegetation about Squaw Spring is a well-established, mesic-adapted assemblage including horsetail (*Equisetum*), cattail (*Typha*), bulrushes (*Scirpus*), rabbitfoot grass (*Polypogon*) and little bluestem (*Andropogon scoparius*), sweet-clover (*Melilotis*) and willows (*Salix*). This vegetation presents a marked contrast to immediately adjacent uplands, where open, silty flats are sparsely covered with ricegrass (*Oryzopsis*) and snakeweed (*Gutierrezia*) and rocky areas support an open woodland of pinyon pine (*Pinus edulis*) and juniper (*Juniperus osteosperma*). Well-developed woodland occurs within a mile of the spring.

Poché (1975) described the habitat where he caught an Allen's big-eared bat in southwestern Utah:

> Vegetation in the wash includes *Tamarix* and *Salix*, and that on the adjacent upland is comprised primarily of blackbrush (*Coleogyne ramosissima*), and infrequent piñon pine (*Pinus edulis*) and juniper (*Juniperus osteosperma*). Grass cover is predominantly *Bromus* and *Hilaria*. Average elevation for the area is 1,250 m with annual precipitation less than 200 mm. The Hurricane Cliffs are located 5 km west of the collection area and descend over 500 m to Warner Valley, which is covered with creosotebush (*Larrea tridentata*), blackbrush, and snakeweed (*Gutierrezia microcephala*). The surrounding region consists of numerous steep rises and mesas, canyons, and cliffs.

Pritchett (no date) and co-workers netted *I. phyllotis* in southwestern Utah in a warm desert shrub community.

Toone (1994) netted *I. phyllotis* in southeastern Utah in an area of "narrowleaf cottonwood, ponderosa pine, pinion–juniper and oakbrush."

Foster et al. (1997) mist-netted Allen's big-eared bat in southern Utah in submontane tall shrubland characterized by *Tamarix ramosissima* (salt cedar), *Salix* spp. (willows), and *Pinus edulis* (piñon).

Jackson and Herder (1997) captured *I. phyllotis* in southern Utah only in desert shrub habitat. (They also reported acoustic detection of this species in riparian and ponderosa pine habitats.)

Day and Peterson (1999a) netted Allen's big-eared bat in the Grand Staircase–Escalante National Monument of southern Utah in 6 of the 7 habitat types that they sampled: riparian (19% of captures), desert shrub (31%), sagebrush (12.5%), piñon–juniper (12.5%), piñon–juniper–sagebrush (12.5%), and mountain brush (12.5%) communities.

Reported elevational extremes at which Allen's big-eared bat has been captured in Utah are -2,500 ft (Pritchett no date) and 7,860 ft (Mollhagen and Bogan 1997). (It also has been reported in Utah, based on acoustic detection, as high as 8,700 ft [Jackson and Herder 1997].)

Conservation

Barbour and Davis (1969) mentioned: "The [*I. phyllotis* maternity] colony [in Arizona] described by Commissaris (1961) has been revisited three times, including the same month a year after the original find, and the bats have never been seen again." Whether disturbance caused by scientific investigation of this maternity colony may have caused its abandonment is not known.

Cockrum et al. (1996) reported that "the major roost [of *I. phyllotis*] in the tunnel at Union Pass [Mohave County, Arizona] has been destroyed by the relocation of the highway and destruction of the tunnel."

Summary

- Taxonomy: generic placement uncertain (*Plecotus phyllotis* and *Euderma phyllote* have been used in the 1990s)
- Utah subspecies: none (or *I. p. hualapaiensis*, if valid)
- Utah distribution: s. and se.
- Utah abundance: rare
- Utah wintering habits: unknown
- Utah habitats: lowland riparian and desert shrub to mountain brush and mixed forest
- Utah elevational range: -2,500 to $7,860 ft

Plecotus townsendii Cooper, 1837
Townsend's big-eared bat

Taxonomy

Some of the earlier literature (e.g., Woodbury 1933, Long 1940, Hardy 1941, Hansen 1951, Durrant 1952, Krutzsch and Heppenstall 1955, Durrant et al. 1955) concerning this bat in Utah assigned it to the species *Corynorhinus rafinesquii*, called the lump-nosed bat by Long (1940) and Hansen (1951) and the long-eared bat by Durrant (1952) and Durrant et al. (1955). Although *rafinesquii* is a recognized species, formerly there was confusion concerning which species this name correctly applied to. For a time the name *rafinesquii* was used for the mostly western species and the name *macrotis* for the strictly eastern North American species. Now the accepted names are *townsendii* for the western and *rafinesquii* for the eastern species.

The species *townsendii* has been transferred back and forth repeatedly between the genera *Corynorhinus* and *Plecotus* by bat taxonomists, especially during the last half of the 20th century, or, stated more accurately, the taxon *Corynorhinus*, to which the species *townsendii* belongs, has been cyclically elevated to full generic status and submerged as a subgenus of *Plecotus*. In fact, the tribe Plecotini to which these taxa belong has been marked by taxonomic instability of its genera and subgenera (e.g., *Idionycteris*), with different studies, using different approaches, suggesting different taxonomic arrangements of species within genera and subgenera. It does not seem likely that the controversy regarding the taxonomic status of New World big-eared bats, *Corynorhinus* (and perhaps even *Idionycteris*), will soon be resolved.

With regard to the status of *Corynorhinus* as either a genus or a subgenus, even Jones et al. (1997), who have attempted to standardize mammalian nomenclature in North America north of México, were equivocal, writing: "We retain the name *Plecotus* as the genus for the two North American species [*townsendii* and *rafinesquii*], but note that this problem warrants additional study." Although many mammalogists in America follow the taxonomic arrangements recommended by the "Texas Tech mammal list", Jones et al. (1997) being the most recent edition, generic placement of the big-eared bats *townsendii* and *rafinesquii* is one of the most debatable of the taxonomic arrangements recommended in the checklist by Jones et al. (1997). (See Jones et al. [1997] for recent references pertaining to this generic debate.)

The race of Townsend's big-eared bat that occurs in Utah is *Plecotus townsendii pallescens* (e.g., see Hall 1981). Durrant et al. (1955) discussed the possibility that the subspecies *intermedius* may occur in northern and northwestern Utah, which was suggested by reported occurrences in Nevada and Idaho, but he tentatively assigned

all Utah specimens to *pallescens*; *intermedius* is no longer regarded as a valid subspecies, having been placed in synonymy with *pallescens*.

Pierson et al. (1999) stated that *Corynorhinus townsendii townsendii* [= *P. t. townsendii*] possibly occurs in northwestern Utah and also suggested that "a possible small zone of intergradation [of *C. t. pallescens* = *P. t. pallescens*] with *C. t. townsendii* [= *P. t. townsedii*] in the northwest corner of the state [of Utah]" may exist. However, this strongly disagrees with the distribution of *P. t. townsendii* as mapped by Hall (1981) and as stated by Koopman (1994), who considered *P. t. townsendii* to be limited to Pacific coastal areas far from Utah.

Status in Utah

Distribution

Townsend's big-eared bat occurs throughout Utah. Although Durrant (1952) thought that this species was present only in the southern two-thirds of the state, Durrant et al. (1955) reported specimens from northern Utah and concluded that "it probably is state-wide in distribution in suitable habitats." Shuster (1957) considered it to be of statewide occurrence, noting that it was known from all but the northwestern part of the state. Barbour and Davis (1969) conservatively mapped *P. townsendii* as occurring in all but the northwestern corner of Utah. Hasenyager (1980) considered this species to occur throughout Utah, and it was mapped by Hall (1981), followed by Kunz and Martin (1982), as hypothetically occurring in all parts of the state.

Wintering Habits

In Utah the wintering habits of Townsend's big-eared bat are better known than those of any other bat species. *P. townsendii* is well known as a hibernator in Utah, utilizing caves and mines as hibernacula.

Concerning *P. townsendii*, Hardy (1941) stated: "In Utah they hibernate throughout the winter." Durrant (1952) wrote of this species: "On February 19, 1933, I took eight as they were hanging from the roof of a coal mine in Pete Canyon west of Wales, Sanpete County, Utah, where they were suspended in small clusters or singly from cracks in the roof of the tunnels. They were hibernating but moved when handled."

Twente (1960) studied hibernation of bats in Utah and wrote:

> During the course of this study, *Plecotus townsendii* have been found hibernating frequently in mines and caves; usually there are only one or two per cavity although as many as thirteen have been found in one cave. ... The reason *Plecotus townsendii*, the only hibernator found with any frequency, occurs in seemingly unsuitable, single-entrance cavities is because of its rather unique habitat selection behavior (Twente 1955). Whereas most bats inhabit the dark regions of caves, *Plecotus*, when there is a difference in temperature within the cavity, selects the cooler places in the twilight zone. Thirteen individuals were seen during one visit in this zone in Logan Cave and none deeper within the cave.

Stock (1965) commented on hibernation of *P. townsendii* in Washington County:

> Hibernating groups examined in the main shaft of Black Warrior Mine, 2.5 miles northeast of Castle Cliff, were composed of males and females in a normal 1:1 ratio. ... Hibernating individuals usually hang either singly or in small groups from the ceiling of mine shafts or other similar hibernacula. Several individuals examined on February 12, 1960, in a small cavern near Santa Clara Creek, one-half mile south of Ivin's Reservoir, were in deep hibernation and barely moved when handled. Air temperature near these bats was 8EC. Repeated visits to this hibernating group and to the one previously mentioned, indicated that the bats had moved about the hibernating area between visits and at times as indicated by previous counts some of the bats were even missing. Banding records by Twente (1955) indicate that these bats disperse widely during hibernation and that some movement occurs from cavern to cavern even during the coldest weather.

Lengas (1994a) found hibernating Townsend's big-eared bats in a cave in Cache County:

> 20 Feb 1992: 13 *P. townsendii* individuals were found hibernating about 3 m up on the walls of the 1st level of the cave, 15-25 m from the entrance. ...
> 20 Mar 1992: 2 *P. townsendii* individuals were noted hibernating about 3 m up on the walls of the 1st level of the cave, 15 m from the entrance ....
> 7 Feb 1993: 4 *P. townsendii* individuals were noted hibernating about 3 m up on the walls of the 1st level of the cave, 15-25 m from the entrance.

Hibernating Townsend's big-eared bats were found in 2 abandoned mines at Dugway Proving Ground in Tooele County in January 1996 (Ageiss 1996). In 1 mine there were 2 *P. townsendii*: "One bat was 8 m from the portal, where the air temperature was 7.0EC, and second bat was 18 m from the portal where the air temperature was 7.5EC." In another mine the hibernating Townsend's big-eared bat was 5 m from the portal, where the air temperature was 8.0 EC.

Lengas (1997a) found 19 hibernating *P. townsendii* in 5 abandoned mines in Piute and

Sevier counties, 4–7 February 1997. There were from 1 to 8 (average = 3.8) individuals in each of the mines that were being utilized as hibernacula, and the hibernating Townsend's big-eared bats were situated from 5 to 108 m into the mines from the portals. Air temperatures at the locations of the individual bats varied from –0.9 EC to 5.6 EC, and the relative humidity where the bats were found ranged from 50 to -62%. Lengas (1997b) reported finding 1 hibernating *P. townsendii* in an abandoned mine in Tooele County on 10 March 1997. The bat was 4 m from the mine entrance; air temperature near the bat was 7.1 EC, and relative humidity farther into the mine was 64%. Lengas (1997c) found 2 hibernating Townsend's big-eared bats in an abandoned mine in Carbon County on 5 November 1997; both were 19 m from the entrance, and at this location air temperature was 6.7 EC, relative humidity 46%.

Sherwin (no date, b) found 68 Townsend's big-eared bats in 20 abandoned mines in Sevier and Piute counties during cold-season surveys. In each inhabited mine there were 1 to 13 *P. townsendii* (mean = 3.4). Presumably all of these bats were hibernating, and in many cases Sherwin (no date, b) specified that this was so. Elevations of the inhabited mines were 6,060 to 8,851 ft.

Abundance

Townsend's big-eared bat appears to be relatively common in Utah, but the question of its abundance in the state is clouded by biases inherent to the various collecting techniques used for bats. Before the 1960s the main techniques used for bat research were the use of guns (i.e., shooting bats with dust shot or rat shot) and cornering bats in, or picking bats from, a few types of roosts—usually caves, mines, and buildings. Since the 1960s the use of mist nets (and other trapping methods such as harp traps) has grown to become the most important method for capturing bats; however, bats species differ greatly in their susceptibility to mist-net capture, some species being readily netted and others, like Townsend's big-eared bat, being poorly sampled using mist nets. It is probably the effect that this change in techniques—from the raiding of roosts and shooting to the use of mist nets—has had on bat work that has produced such inconsistent results concerning the abundance of *P. townsendii* in Utah. Early works, based on moderately large samples (for their time) of Utah bats, suggest that *P. townsendii* is one of the commonest bat species that occur in Utah. Recent mist-net studies suggest just the opposite. This pattern can be seen in the results summarized below.

Hardy (1941) examined 204 bat specimens of 15 species from Utah; 40 of these (20%) were *P. townsendii*, which was the 2nd most abundant bat in this state based on the numbers examined by him.

Durrant (1952) examined 182 Utah bat specimens of 14 species (15, if corrected or a re-identification); 20 of these specimens (11%) were Townsend's big-eared bat, which ranked 3rd in abundance.

Shuster (1957) examined 372 specimens of bats from Utah; 55 (15%) were *P. townsendii*, the 3rd most common bat in her sample of 15 species.

Hasenyager's (1980) review of Utah bats was done well after mist-netting had become the popular technique for working with and collecting bats in Utah, as it had elsewhere, but it included many specimens collected much earlier using pre-mist-net techniques. Hasenyager (1980) gave the number of individuals from the Utah records that he compiled as 90 (the actual sum was 85 plus 3 occurrences of unknown number), which was ~7% of all his Utah bat records, and this species was the 5th most numerous of the 18 bat species in his Utah review.

Since Hasenyager's (1980) work, practically all Utah bat studies that have been reported and that have sampled large numbers of individuals at multiple sites over moderate to very large areas have found *P. townsendii* to be one of the rarest bats, as the results of the studies cited below, all from the 1990s and all using primarily, if not only mist nets, show.

None of the 264 or 265 bats of 10 species mist-netted in 1991 by Pritchett (no date) and his co-workers in Washington County was *P. townsendii*.

Lengas (1994b), too, captured no *P. townsendii* among the 220 bats of 9 species that he mist-netted in northern Utah.

Among 157 bats captured in and near Dugway Proving Ground (Ageiss 1996), Tooele County, 6 (4%) were *P. townsendii*; this species tied with 1 other at the middle of the range of abundance of the 10 species caught.

Of 572 bats mist-netted in the Henry Mountains area by Mollhagen and Bogan (1997), 16 (2.8%) were *P. townsendii*. This species ranked 10th in abundance of the 15 bat species captured in their study.

Only 10 (1.6%) of the 609 bats captured and identified by Jackson and Herder (1997) in southern Utah were *P. townsendii*, which ranked 10th in abundance of the 16 species that they caught.

In the Grand Staircase–Escalante National Monument of southern Utah, only 7 (1.1%) of the 640 bats mist-netted by Day and Peterson (1999a) were Townsend's big-eared

bat, which was 10th in abundance of the 13 kinds (13 or 14 species) of bats that they caught.

Of 179 bats netted by Day and Peterson (1999b) in southwestern Utah, only 2 (1.1%) were *P. townsendii*, and only 1 of the 10 kinds (10 or 11 species) of bats that they captured was less numerous.

Thus, pre-mist-net studies place *P. townsendii* as the 2nd or 3rd most abundant bat in Utah; Hasenyager's (1980) study combines the earlier data obtained using the old bat-collecting methods with the new and puts *P. townsendii* in 5th place; and most of the mist-net studies of the 1990s have either failed to detect this species at all or have found it to be uncommon, in 9th or 10th place. It does not seem likely that these results represent a population decline among *P. townsendii* in Utah, but rather, as previously stated, merely sampling biases, for mine and cave studies continue to show *P. townsendii* to be common in those roosts in Utah.

Habitat

Habitats utilized by Townsend's big-eared bat in Utah include: desert shrub, piñon–juniper, piñon–juniper–sagebrush, mountain brush, mixed forest, and ponderosa pine forest. Mines and caves are used by this species in Utah as day and night roosts. Buildings, caves, and mines in Utah are used as day roosts and maternity roosts.

Long (1940), discussing *P. townsendii* in Utah, reported: "A small colony of this species was found at Fort Beaver on July 28, 1936, in the same ruined building which harbored a mixed colony of big brown and free-tailed bats. They were in the main part of the attic, clinging to the roof in a cluster less than a foot in diameter. Because of the numerous holes in the roof, the attic was little darker than an ordinary room; no other species of bat was found in this light part of the building." Apparently this was a maternity colony, for he mentioned "adult females, [and] … immatures that were large enough to fly, … [but] [o]nly one small young was seen—a nearly naked one that was clinging to a nipple of one of the females." He also found adult males near, but not within, this colony—1 one the basement of the same building and 6 in the attic of a nearby building.

Hardy (1941) stated that "these bats are most common in mines or caves" and provided Utah specimen records from 5 mines and 1 cave. He noted: "Even shallow prospect-holes usually contain one or more of this [bat species]." He also mentioned a Townsend's big-eared bat that was found "in the attic of an abandoned house" in Utah. Hansen (1951) mentioned: "One specimen [of *P. townsendii*] from Gold Hill, Deep Creek Mountains, was taken in a shallow prospect hole."

Musser (1961) found 7 Townsend's big-eared bats roosting in the attic of a recreation hall in Holden in September. He also found mummified and completely skeletonized remains of more than 21 *P. townsendii* in the attic of the Richfield courthouse, and among these were newly born individuals and 2 females containing embryos, demonstrating that it had been used as a maternity colony.

Stock (1965) wrote of *P. townsendii*: "These bats are commonly found in caves and mine tunnels throughout [Washington County]. The colonies that I have found during summer invariably have been nursery colonies composed of young individuals and adult females. … The nursery colonies that I have observed pass the daytime hours in compact clusters, often in somewhat open and lighted areas."

Poché (1981) noted that he found Townsend's big-eared bats in caves in Washington County but gave no details.

Lengas (1994a) discussed the use by bats of several caves and abandoned mines in Cache and Weber counties in northen Utah. In his surveys of these caves and mines, he found single individuals of *P. townsendii* in 1 cave and 1 mine, and large numbers of this species in 2 caves—at times as many as 150 in 1 cave, which was used as a diurnal roost, a hibernaculum, and, at least in some years (depending on human disturbance), a maternity colony, and 245 in another, used as a roost and a maternity colony.

Lengas (1997a, 1997b, 1997d, 1998) reported abandoned mines in various parts of Utah that were used as day and sometimes night roosts by small numbers (1 to 3) of *P. townsendii*: 4 abandoned mines in south-central Utah that were used as both day and night roosts by small numbers (1 to 3) of *P. townsendii* (Lengas 1997a), 5 abandoned mines in north-central Utah that were used as day roosts by single individuals (Lengas 1997b), 4 abandoned mines in east-central Utah that were used by small numbers (1 or 2) *P. townsendii* as day (and probably night) roosts (Lengas 1997d), and 3 abandoned mines in southeastern Utah that were used by single individuals as day roosts (Lengas 1998).

Jackson and Herder (1997) reported that they captured *P. townsendii* in desert shrub (50%) and piñon–juniper (10%) habitats in southern Utah; they also indicated that caught this species (40%) at a moderately high elevation site, 8,700 ft, but did not provide habitat information for this location. (Additionally they reported acoustic detection of Townsend's big-eared bat in dry meadow and wet meadow–mixed forest habitats in the same southern Utah study.)

In the Grand Staircase–Escalante National Monument of southern Utah, Day and Peterson (1999a) mist-netted *P. townsendii* in piñon–juniper (14%), piñon–juniper–sagebrush (57%), and mountain brush (29%) habitats.

In their southwestern Utah bat study, Day and Peterson (1999b) captured *P. townsendii* at a cave in mixed forest habitat (100%). They also reported that Townsend's big-eared bat had been captured by others at another cave in their study area that is in ponderosa pine forest.

Pierson et al. (1999) stated: "There are currently 15 known maternity roosts [of *P. townsendii*] in Utah: including 6 in caves and 9 in abandoned mines. Maternity colonies range in size from 15 to >500 mature females."

Reported elevations at which *P. townsendii* has been captured or examined in Utah range from 3,300 ft (Durrant 1952, Shuster 1957) to 8,851 ft (Sherwin no date, b). (However, Jackson and Herder [1997] acoustically detected *P. townsendii* at 9,520 ft elevation in southern Utah.)

Conservation

Long (1940) reported that, the day after the discovery and disturbance of a roost, apparently a maternity colony, in the attic of a ruined building in Utah, it was abandoned except for 2 individuals. Barbour and Davis (1969) discussed this sensitivity of *P. townsendii* to disturbance of maternity colonies and hibernacula:

> Although nursery colonies prefer the edge of the lighted zone in a cave, disturbance will cause the entire group to move to a remote section or the leave the cave entirely. Pearson *et al.* (1952) found that banding the young at night after all adults had left to feed apparently caused the colony to move. During the same night that 75 young were banded, the adults returned, picked up young, and moved to another roost 1.3 miles away. ... Hibernating *P. townsendii* seem almost as intolerant of disturbance as the summer groups. Twente (1955b) noted that those banded in Kansas caves in winter left the caverns for weeks or months, and many never returned.

Musser (1961) reported that a roost of Townsend's big-eared bats that he examined, and collected bat specimens from, in the attic of a building in Holden in September, was vacant the following May. He commented: "Several residents of Holden told me that several months subsequent to my first visit ..., the smoke from a fire which had started in the back of the building filled the attic and remained there for several days. This may have been a factor in the absence of bats from this roosting site in May." Musser may have been correct that the smoke may have been a factor in the abandonment of the roost; however, the fire and the smoke that it produced apparently occurred during the winter, and *P. townsendii* seldom uses buildings for hibernation. Thus, although the cause of abandonment of this site cannot be known, it is plausible that Musser's disturbance of the roost, which evidently involved considerable chasing of the bats, may itself have been the cause.

Musser (1961) also discussed finding remains of Townsend's big-eared bats in the attic of a building in Richfield:

> The cause or causes responsible for the death of these bats are unknown. The differential states of decay present suggests that death occurred at different periods and not to all individuals at the same time. ... The custodian of the building told me that he had placed naphthalene balls in the attic in the early part of the summer in the hope of driving out the large colony of 'small black bats' then present in the attic. Naphthalene balls, however, usually only repel bats, and rarely kill them. In addition, the state of decay of the specimens suggests that the animals had been dead for a longer period before placement of the naphthalene balls in the attic.

Lengas (1994a), discussing roosts of *P. townsendii* in northern Utah, wrote:

> Townsend's big-eared bats are very sensitive to disturbance from humans; simply walking past a colony in summer can cause them to abandon the roost. During the hibernation period they can be awakened by the noises or changes in air temperature caused by people passing through the hibernaculum; this can cause an increase in the rate at which they burn fat reserves, resulting in death before the arrival of spring.

Between September 1990 and September 1993 Lengas (1994a) periodically surveyed a cave used as a diurnal roost, a hibernaculum, and a maternity roost by Townsend's big-eared bats in Cache County and documented human disturbance that included:

> 1 dead *P. townsendii* individual had been shot and was found on the cave floor.
>
> [T]he remains of a large fire and a strong smell of smoke were noted in the 2nd level, along with a rope providing easy access from the 1st level of the cave.
>
> [T]he remains of 2 large fires and several packages of firecrackers were found on the 2nd level ...; a strong smell of smoke was evident.
>
> [T]he remains of several bottle rockets and sparklers were ... found .... 3 people were in the 2nd level at the time of the survey; "ladders" providing easy access from the 1st to the 2nd level were present ....
>
> [T]he remains of another fire and a strong smell of smoke were noted ...; "ladders" to the 2nd level were still present ....
>
> 4 empty packages of sparklers ... were noted in the immediate area of the bats; 2 people were present in the 2nd level at the time of the survey ....
>
> [T]he remains of 2 fires were observed just inside the entrance of the 1st level.

He (Lengas 1994a) commented:

> [I]t is evident that the bats were too greatly disturbed in 1993 to form a maternity colony and give birth to their young; it is not known whether they were able to form a maternity colony elsewhere. Loud noises (explosions) inside a cave can leave bats deafened, and smoke from fires generally drives them away from their roosts. There was evidence that a great number of people were visiting the 2nd level of the cave where the bats normally roost ....

Lengas (1994a) reported that, on 12 September 1993 at a large maternity roost of Townsend's big-eared bats in a cave in Weber County, "the bodies of 46 dead juvenile *P. townsendii* individuals were found". Concerning these dead juvenile bats he wrote:

> It is clear from the litter on the trail to the cave and the graffiti on the cave walls that numbers of young people are visiting the cave each summer .... The large number of dead young bats may have been caused by their visits. During a summer visit to the cave three years ago, a Wasatch Grotto member reported seeing approx. 90 dead bats on the cave floor ... and noted that many of the bats appeared to have suffered broken bones.

Pierson et al. (1999) stated:

> There are 13 historically known maternity and hibernating colonies that no longer exist (3 in caves, 8 in mines, and 2 in buildings) [in Utah]. Seven of these sites (1 cave, 6 mines) have been sealed, and the rest have been abandoned. Most notable of which are 2 maternity colonies that are believed to have been entombed as a result of mine reclamation. A large maternity roost above Alpine, Utah, was closed by the USFS [U. S. Forest Service] in July, 1991, and it is most likely that the colony was entombed as a result of this closure. Another large mine was closed by a local law enforcement agency near Elberta, Utah. This mine was used as a roost by several species, including a maternity colony of *Corynorhinus townsendii* [= *P. townsendii*]. This site was closed in 1989 with the bats roosting inside. The remaining mines were most likely closed as a result of natural subsidence. ... Five of the 9 [currently known maternity] roosts in abandoned mines have been gated by the Utah Division of Oil, Gas & Mining Abandoned Mine Reclamation Program (UDOGM, AMRP), as have 2 of the [currently known maternity roosts in] caves (by USFS). The UDOGM abandoned mine reclamation program is actively surveying and closing abandoned mines throughout the state, and follows a pre-closure survey protocol, developed to identify and protect bat roosts ....

Summary

- Taxonomy: unstable—variously placed in *Plecotus* and *Corynorhinus*

- Utah subspecies: *P. t. pallescens*
- Utah distribution: all
- Utah wintering habits: hibernates in caves and mines
- Utah abundance: common
- Utah maternity colonies: caves, abandoned mines, and buildings
- Utah day (and night) roosts: caves, abandoned mines, and buildings
- Utah habitats: desert shrub to montane forest
- Utah elevational range: 3,300 to $8,851 ft

Antrozous pallidus (Le Conte, 1856)
pallid bat

Taxonomy

The subspecies of the pallid bat that occurs in Utah is the type race, *Antrozous pallidus pallidus* (see Martin and Schmidly 1982).

Presnall (1938) reported *Antrozous pallidus pacificus* from Zion National Park. Hardy (1941) re-examined Presnall's specimens and assigned them, as well as specimens from Millard County, to the race *A. p. cantwelli*. However, Hardy's (1941) reasoning concerning subspecific assignment of these specimens is difficult to understand; he wrote: "Specimens from the southern and western part of Utah present a problem in classification because of their great variability. They are obviously intergrades between *pallidus* and *pacificus* but ... 'are not referable to either.'" He also noted: "A female taken ... [in St. George] on March 29, 1939, seems very close to *pallidus* and may have been a migrant, but another female taken April 6, 1939, is much larger and is referred to *cantwelli*." Durrant (1952), though, did not consider specimens from these areas to be either *A. p. cantwelli* or intergrades and tentatively assigned all specimens from Utah to the race *A. p. pallidus*. Martin and Schmidly (1982) placed *A. p. cantwelli* in synonymy with *A. p. pallidus* and considered all pallid bats in Utah to be the latter subspecies; they also noted that "[c]onsiderable geographic variation exists within *A. p. pallidus*."

Status in Utah

Distribution

The pallid bat possibly occurs throughout Utah in proper habitat, but records are lacking from the most of the north-central and northwestern parts of the state and from the Wasatch and Uinta mountains and most of the mountains of the High Plateaus of the central part of Utah.

Durrant (1952) and Shuster (1957) considered the pallid bat to occur in Utah only in the southern and eastern parts—roughly the southeastern half of the state, and Barbour and Davis (1969) mapped the distribution of this species in Utah similarly but indicated that it occurred to the northeastern corner of the state, where the Utah, Colorado, and Wyoming boundaries meet. Hasenyager (1980) reported localities in Tooele and Box Elder counties and commented that "[c]aptures ... in north-central Utah have extended

the range to now include all of the state." Hall (1981) mapped the Utah distribution much as Barbour and Davis (1969) had, omitting all of northwestern Utah from this bat's range. Martin and Schmidly (1982) mapped the pallid bat's range as including all but the northeastern corner of Utah. Hermanson and O'Shea (1983), although they cited Martin and Schmidly (1982), apparently did not agree with them that *A. pallidus* occurs in northwestern Utah, northeastern Nevada, and southern Idaho and simply repeated Hall's (1981) distribution map for this species. Ports and Bradley's (1996) record of the pallid bat in northeastern Nevada and Bogan and Cryan's (2000) records of this species from Wyoming reaffirm the possibility that the species may occur in much or all of northwestern and northern Utah.

Wintering Habits

The pallid bat is known both to hibernate in caves in Utah and, at least in the extreme southwestern part of the state, to be active in winter.

Hardy (1941) mentioned that a pallid bat collected in St. George on 29 March "may have been a migrant".

Twente (1960) reported: "A single specimen of *Antrozous pallidus*, probably representing a hibernating individual, since it was taken November 15, 1931, from a 'lava cave, Meadow' (Millard County), is in the University of Utah Museum of Mammals." (This must be the single specimen, from a cluster of 10 males mentioned by Hardy [1941], that Hardy noted as being in the University of Utah collection.) Twente (1960) also commented: "Although only one winter record of *Antrozous* exists from Utah, they have been seen hibernating in vertical cracks in the ceilings of a Nevada mine (Alcorn 1944). This seems to be the typical type of hibernaculum selected by this genus (Twente 1955[a]) and should deep vertical cracks be found near the entrance of mines or caves, it is probable that populations will eventually be found." Apparently a small hibernating group of pallid bats *had* already been found in Utah by Hardy (1941), whom Twente (1960) cited, and the characteristics of the site reported by Hardy (1941) match almost exactly the conditions to which Twente (1960) tied his Utah prediction. Hardy (1941) had reported 10 individuals, 1 of them a specimen in the University of Utah collection, that had been collected from "[v]olcanic caves 10 mi. W Meadow" in Millard County. Although Hardy (1941) made no mention of hibernation and did not provide the date, he commented: "The [pallid] bats from Millard County were taken from a large crack in the roof of a cave. They were near the entrance of the cave. All specimens in the cluster were males."

Ruffner et al. (1979), studying winter activity of bats in extreme southern Washington County near the Arizona border, reported: "Five pallid bats (*Antrozous pallidus*) were captured [with mist nets] in December 1974 and January 1975. Ambient

temperatures at the time of capture ranged from –5E C to 1E C." Poché (1981) also mentioned that he netted 7 *A. pallidus* in winter (apparently "November 1974 to March 1975, and January 1976") at the same locality; probably 5 of his 7 pallid bats were those reported by Ruffner et al. (1979).

Abundance

The pallid bat is fairly common in Utah. At lower, more arid sites in Utah, it is often one of the 3 most abundant bat species, but at higher elevations it is rarer, sometimes apparently being absent altogether.

Of the 204 bat specimens from Utah that Hardy (1941) examined, 23 (11%) were the pallid bat; this was the 5th most numerous of the 15 bat species of which Hardy (1941) examined Utah specimens.

Durrant (1952) examined 182 bat specimens from Utah; these included 14 specimens of *A. pallidus* (8%), which was the 5th most numerous of the 14 species (15,when corrected for a re-identification) of which he saw specimens.

Among the 372 Utah bat specimens examined by Shuster (1957), 19 (5%) were pallid bats; this species ranked 8th in abundance of the 15 species for which she had specimens.

Hasenyager (1980) listed 41 Utah individuals of *A. pallidus*, which was 12th in order of abundance of the 18 bat species in his Utah review and accounted for 3% of his individual bat records.

Pritchett (no date) and co-workers mist-netted 264 or 265 bats in southern Washington County in 1991; of these, 23 (9%) were pallid bats, and this species was the 3rd most abundant of the 10 bat species that they caught.

None of the 220 bats of 9 species mist-netted by Lengas (1994b) in the Ashley National Forest of northern Utah was *A. pallidus*.

Of 157 bats captured in or near Dugway Proving Ground in Tooele County in 1995, 23 (15%) were *A. pallidus*, which was the 3rd most common of the 10 bat species that were caught (Ageiss 1996).

Of 572 bats that Mollhagen and Bogan (1997) mist-netted in the Henry Mountains area of southern Utah, 20 (3.5%) were *A. pallidus*, which ranked 9th in abundance among the 15 bat species that they captured.

Jackson and Herder (1997) identified 609 bats that they captured in southern Utah; 28 (4.6%) were pallid bats, and only 6 of the 16 species that they caught were more abundant than this species.

Day and Peterson (1999a) reported 77 (12%) *A. pallidus* among the 640 bats that they mist-netted in the Grand Staircase–Escalante National Monument of southern Utah; the pallid bat was the 3rd most abundant of the 13 kinds (13 or 14 species) of bats that they captured. None of the 179 bats captured by Day and Peterson (1999b) in southwestern Utah was *A. pallidus*.

Habitat

Situations in Utah inhabited by the pallid bat include: lowland riparian, desert shrub, sagebrush, sagebrush–rabbitbrush, piñon–juniper–sagebrush, piñon–juniper, mountain meadow, and submontane tall shrubland (tamarisk–willow–piñon). It has also been found in towns in Utah, sometimes roosting in buildings. Caves have been reported as roosts in Utah.

Hardy (1941) reported Utah specimens of pallid bats collected "from beneath the casing of a house". He also mentioned a pallid bat "taken … from behind a pile of old books [in a school] in Price …. Piles of guano indicated that it had made its home there for some time."

Stock (1965) wrote: "I have observed these large bats at many localities in the study area [Washington County], generally below 5,000 feet. They seem to prefer desert canyons and slopes." He also mentioned shooting pallid bats "as they foraged for scarab beetles and caterpillars on the cottonwood trees surrounding the ranch house" at Terry's Ranch in Beaver Dam Wash, and he observed this species apparently feeding on insects attracted to street lights in St. George.

Easterla (1965) collected *A. pallidus* near Bryce Canyon National Park in a treeless, rolling area of sagebrush and rabbitbrush; montane ponderosa pine forest was present a few miles away.

Poché (1981) mentioned finding the pallid bat in caves in Washington County but did not provide details.

Pritchett (no date) described 2 locations where this species was netted in southern Washington County as warm desert shrub communities.

Foster et al. (1997) captured *A. pallidus* at one site in southern Utah, which they called submontane tall shrubland; it was characterized by tamarisk, willows, and piñon.

Jackson and Herder (1997) reported the capture of the pallid bat in southern Utah in riparian (64%), desert shrub (25%), and piñon–juniper (7%) habitats and at 1 location for which they did not provide a habitat description (4%) but was a moderately high-elevation site (8,700 ft) that likely was montane forest of some kind. (Additionally, they reported acoustic detection of *A. pallidus* at 2 sites ponderosa pine forest; one of these, at 10,500 ft elevation, is not ponderosa pine but rather spruce–fir forest.)

In the Grand Staircase–Escalante National Monument of southern Utah, Day and Peterson (1999a) captured *A. pallidus* in riparian (9%),desert shrub (60%), piñon–juniper (10%), piñon–juniper–sagebrush (5%), sagebrush (1%), and mountain meadow (14%) habitats.

Extremes of reported elevations at which the pallid bat has been captured in Utah are 2,700 ft (Stock 1965, Ruffner et al. 1979) and 8,700 ft (Jackson and Herder 1997). (Jackson and Herder [1997] also reported that they detected this species acoustically at 10,500 ft elevation in Utah.)

Conservation

Hermanson and O'Shea (1983) summarized known threats to this species throughout its range. These included predation by raptors when pallid bats were released by bat researchers during the day, "slaughter by vandals ..., extermination in buildings, and specimen collecting ...."

Summary

- Utah subspecies: *A. p. pallidus*
- Utah distribution: possibly all; no records in most of n.-c. and nw. or in Wasatch and Uinta mountains and High Plateaus
- Utah winter habits: hibernates in caves; active in winter in sw.
- Utah abundance: common (at lower, drier sites) to uncommon (at higher, wetter sites)
- Utah habitats: lowland riparian and desert shrub to mountain meadows; towns
- Utah elevational range: 2,700 to $8,700 ft

Tadarida brasiliensis (I. Geoffroy Saint-Hilaire,1824)
Brazilian free-tailed bat

Taxonomy

This bat was formerly known as *Tadarida mexicana* (e.g., see Woodbury 1933, Presnall 1938, Long 1940, Hardy 1941, Durrant 1952) and was called the Mexican free-tailed bat. Hoffmeister (1986) has suggested that, instead of Brazilian free-tailed bat, a "far more appropriate" common name for this species is American free-tailed bat.

The race that occurs in Utah is *Tadarida brasiliensis mexicana* (e.g., see Hall 1981). Although Musser (1961) stated that he was referring all specimens of the Brazilian free-tailed bat from the Pavant Range (and its vicinity) to *Tadarida brasiliensis brasiliensis*, a South American race that occurs only as far north as southern Central America, this was clearly a lapsus, for both in his checklist and the heading for the account of this bat he identified it as *Tadarida brasiliensis mexicana*.

Status in Utah

Distribution

The Brazilian free-tailed bat is known to occur in all but the northernmost parts of Utah (Box Elder–Daggett counties); possibly it occurs throughout Utah except for the higher mountain ranges such as the Wasatch and Uinta mountains.

Durrant (1952) considered *T. brasiliensis* in Utah to be "[p]ractically state-wide in distribution" even though he mapped this species as present only in the southern three-quarters of the state. Shuster (1957) wrote of this species: "Probably state-wide, no specimens from the extreme northern part of state, however." Hasenyager (1980) considered this species to be "found statewide except for the northern counties". Barbour and Davis (1969) and Hall (1981) mapped the distribution of the Brazilian free-tailed bat in Utah much as Durrant (1952) had.

The possibility that the Brazilian free-tailed bat occurs throughout Utah is suggested by a record of this species in northeastern Nevada (Ports and Bradley 1996) and by records in 3 widely separated localities for *T. brasiliensis* in Wyoming (Stromberg 1982, Bogan and Cryan 2000). The closest of these Wyoming localities to Utah is Pinedale, Sublette County (Bogan and Cryan 2000), which is approximately 85 miles

northeast of the northeast corner of Rich County, Utah. Bogan and Cryan (2000) noted, however, that these Wyoming records, each based on a single individual, were difficult to interpret: "The records may be attributed to wandering individuals, or they may represent still-undiscovered colonies in the state."

Wintering Habits

Some *T. brasiliensis* in Utah migrate out of the state for the winter, while others overwinter, perhaps facultatively hibernating and emerging in response to variations in winter temperatures.

Hardy (1941), writing of the Brazilian free-tailed bat in Utah, stated: "They seem to hibernate often in houses."

Twente (1960), however, considered *T. brasiliensis* to be among the Utah bats that "are known to be migratory elsewhere within their geographical ranges and have not been reported from Utah except during the warmer months."

Stock (1965) reported "[t]he roosts that I have examined [in Washington County] in mid-October were empty of [Brazilian free-tailed] bats and presumably they had departed south." However, Ruffner et al. (1979) mist-netted 9 *T. brasiliensis* in southern Washington County in January and February at ambient temperatures of 0 to 4 EC, demonstrating not only that at least some Brazilian free-tailed bats remain in Washington County through the winter but also that they are active even at freezing temperatures. Poché (1981) also reported winter mist-net captures of 11 *T. brasiliensis* in southern Washington County from November 1974 to March 1975 and January 1976; this count probably includes the 9 reported by Ruffner et al. (1979) in winter at the same locality.

Wilkins (1989) stated that the population of *T. brasiliensis* in southwestern Utah "migrates westward and southwestward into southern California and Baja California. Those in southeastern Utah ... migrate into Jalisco, Sinaloa, and Sonora along the western side of the Sierra Madre Occidental."

It has been suggested that 3 specimens of *T. brasiliensis* collected in Tooele County during late August and September may have been migrants (Ageiss 1996), but no explanation was given for this interpretation.

Mollhagen and Bogan (1997) reported capturing 8 females and 36 males of this species on 19 May 1996 at a single locality in southern Utah and commented that "[i]t is likely that these individuals were migrating."

Abundance

The Brazilian free-tailed bat is abundant in Utah. However, in Utah studies at higher elevations or in the northern part of the state it has been found to be 1 of the rarest bats or has not been represented at all.

Hardy (1941) wrote of *T. brasiliensis*: "In the southern part of Utah, these bats are very common."

Of 204 Utah bats examined by Hardy (1941), 25 (12%) were *T. brasiliensis*, which was the 3rd most numerous of the 15 species for which he examined specimens from this state.

Durrant (1952) examined 15 specimens of *T. brasiliensis* from Utah; this species was the 4th most numerous of the 14 bat species (15, if corrected for a later re-identification) of which he examined specimens, and it represented 8% of all the bat specimens from the state seen by him.

Only 9 (2%) of the 372 Utah bat specimens examined by Shuster (1957) were the Brazilian free-tailed bat, which ranked 11th in order of abundance among the 15 bat species for which she examined specimens.

Stock (1965), commenting on the Brazilian free-tailed bat on Washington County, stated: "They are common throughout the valleys of the study area, and are especially abundant in towns ...."

Hasenyager (1980) gathered records of 106 *T. brasiliensis* in Utah; this species represented 9% of the approximately 1,212 individual bats from Utah known to him, and it was the 4th in order of abundance among the 18 Utah bat species in his study.

Pritchett (no date) and co-workers mist-netted 134 *T. brasiliensis* in southern Washington County in 1991; it was the most abundant of the 10 bat species that they secured, representing 51% of the 264 or 265 bats captured.

None of the 220 bats of 9 species mist-netted in the Ashley National Forest of northern Utah by Lengas (1994b) was the Brazilian free-tailed bat; however, this area is beyond the known range of *T. brasiliensis* and the 14 sites that were sampled were at elevations (mean = 7,732 ft) that are somewhat high for this species.

Of 157 bats captured in and near Dugway Proving Ground in Tooele County, only 1 (0.6%) was a Brazilian free-tailed bat, which was tied with 3 other species as the rarest of the 10 bat species that were caught (Ageiss 1996).

Of 572 bats mist-netted in the Henry Mountains area of southern Utah by Mollhagen and Bogan (1997), 50 (9%) were *T. brasiliensis*, which was the 6th most common of the 15 species that they captured.

Jackson and Herder (1997) reported that 38 (6%) of the 609 bats that they captured and identified in southern Utah were the Brazilian free-tailed bat; it was the 3rd most abundant of the 16 species that they caught.

Only 3 (< 0.5%) of the 640 bats mist-netted by Day and Peterson (1999a) in the Grand Staircase–Escalante National Monument of southern Utah were *T. brasiliensis*, which tied with 2 other species as the rarest among the 13 kinds (13 or 14 species) of bats that they captured.

Among 179 bats that Day and Peterson (1999b) captured in southwestern Utah, only 1 (0.6%) was a Brazilian free-tailed bat, and this was the rarest of the 10 kinds (10 or 11 species) that they caught.

Habitat

In Utah the Brazilian free-tailed bat inhabits cities and towns and a variety of natural habitats including: lowland riparian, desert shrub, and ponderosa pine forest. Roosts reported in Utah have included attics and other parts of buildings, crevices in cliff faces, and possibly a cave.

Long (1940) reported 2 roosts of *T. brasiliensis*, both shared with *Eptesicus fuscus*, in buildings in Utah. One was under "the eaves of one of the ruined barracks at old Fort Beaver .... The projecting edges of the roof had bee boarded up on both sides of the rafters, leaving a dark space inside. ... [I]t was found that the big brown bats were in the peak of the eaves while the free-tails were mostly by themselves lower down. ... [A]nother mixed colony of big brown and free-tailed bats was found in the attic of an occupied house .... Although there was some mingling of the two species, most of the individuals were grouped separately."

Hardy (1941) wrote of a roost of Brazilian free-tailed bats in a building in Utah: "Before recent repair work on the Education Building at Dixie Junior College, it was possible to use a hydrogen sulphide gas generator and by placing a rubber tubing beneath the exterior window casings, drive out these bats and thus capture them."

Despite the fact hat she cited Hardy (1941), who had mentioned Utah colonies, citing Long (1940), Shuster (1957) stated: "In Utah, no retreats where these [Brazilian free-tailed] bats assemble in large numbers have been found. All specimens that I have examined were taken singly." It is true, however, that no colonies numbering in the

millions, so well known in Texas and some other states, have been reported in Utah.

Musser (1961) collected specimens of Brazilian free-tailed bats from the attics of 5 buildings in Holden and 1 building in Richfield. Apparently *T. brasiliensis* used these roosts only during summer, for Musser found that 1 of them contained no bats on 24 April but on 28 May was occupied by more than 300 individuals by his estimate, and he was told by the owner of the building that they were never there during the winter. At least 2 of these roosts seemingly were maternity colonies. Of 82 *T. brasiliensis* that Musser collected from the large colony of 300 or more, all but 1 were females, and only 4 of the 81 females "lacked any apparent embryos." Musser collected 15 of approximately 50 Brazilian free-tailed bats from another attic, and 14 of these bats were females, all containing embryos. Musser also found Brazilian free-tailed bats using a vertical crevice in a sandstone cliff face in Fillmore Canyon as a roost. The opening of the crevice was "approximately five feet in length and three inches at the widest point." This roost, too, may have been a maternity colony; the 1 specimen that he collected from it was a female that was lactating.

Stock (1965) noted that in Washington County "in towns … they [*T. brasiliensis*] roost in great numbers in recesses of old buildings." He also found them "throughout the valleys of the study area [Washington County]" and "over water holes or reservoirs below 6,000 feet."

In many parts of the range of *T. brasiliensis*, this bat roosts in caves. The only indication of the possible use of caves by the Brazilian free-tailed bat in Utah that has been found in the literature comes from Hasenyager's (1980) list of known occurrences of this species, which includes a location that is a cave in Tooele County near the Nevada border. However, since this was given simply as a locality, it remains uncertain whether the cave was actually used as a roost.

Pritchett (no date) and co-workers captured Brazilian free-tailed bats at 3 of their 4 net sites in Washington County; all 3 of these sites were in warm desert shrub communities.

Jackson and Herder (1997) captured *T. brasiliensis* in southern Utah in riparian (76%), desert shrub (18%), and ponderosa pine (3%) habitats as well as 1 location (3%) for which no habitat was specified. (They also reported that they detected this bat acoustically in juniper, piñon–juniper, and dry meadow habitats and at a site that they called ponderosa pine but is actually spruce–fir forest.)

Day and Peterson (1999a) mist-netted the Brazilian free-tailed bat at only 1 of 28 sample sites in the Grand Staircase–Escalante National Monument; they classified the habitat as riparian and mentioned that it was in a small canyon.

Day and Peterson (1999b) captured *T. brasiliensis* at only 1 of the 15 sites that they sampled for bats in southwestern Utah; this site was a wet meadow in ponderosa pine forest.

The Brazilian free-tailed bat has been captured in Utah at reported elevations as low as about 2,500 ft (Pritchett no date) or 2,600 ft (Stock 1965) and as high as 8,000 ft (Shuster 1957). (Jackson and Herder [1997] reported acoustic detection of this species at elevational extremes of 2,400 ft and 10,560 ft in southern Utah.)

Conservation

Long (1940) reported the effect of disturbance on a colony of Brazilian free-tailed bats in an abandoned building in Utah: "… [T]he day following the discovery of the bats …, the colony was completely deserted and there was no further trace of the bats at this locality."

Collecting of bats in Utah, at least in the past, has been intense. For example, Musser's (1961) account of his collecting of Brazilian free-tailed bats from roosts in southwestern Utah (discussed above under *Habitat*) reveals that he took more than a quarter of all the bats that he found in 2 maternity colonies for specimens—82 of an estimated 300 or more and 15 of approximately 50—and that almost all of these were pregnant.

The negative consequences of daytime release of captured bats by researchers is seen in the work of Black (1976) in New Mexico, who released bats during the day "in the hope of obtaining data on location of roosting sires and orientation behavior." Of 10 Brazilian free-tailed bats that he released during daylight, 2 were captured by American kestrels and another was pursued by a kestrel but escaped.

In New Mexico, Geluso et al. (1976) performed experiments on young Brazilian free-tailed bats about to begin their first migration from the natal site. They found that exercise intended to simulate migration caused mobilization of organochlorine toxins (e.g., DDT and its metabolites) and redistribution of these toxins to the brains of the bats, which produced characteristic symptoms of pesticide poisoning and death. They concluded that "the stored organochlorine residues in the fat of young *T. brasiliensis* present a serious threat to these bats during their initial migratory flight", and they believed that pesticide poisoning has contributed to recent declines in populations of *T. brasiliensis*. Wilkins (1989) reviewed information concerning heavy metals, pesticides, and other cumulative toxins in the Brazilian free-tailed bat throughout its range.

Summary

- Utah subspecies: *T. b. mexicana*
- Utah distribution: all but the northernmost counties; possibly all
- Utah wintering habits: some populations migrate, some (sw.) remain and are active at times, even in freezing weather, some presumably hibernate
- Utah abundance: abundant
- Utah habitats: lowland riparian and desert shrub to ponderosa pine forest; cities and towns
- Utah maternity roosts: attics of buildings
- Utah day roosts: buildings, rock crevices
- Utah elevational range: #2,600 to $8,000 ft

Nyctinomops macrotis (Gray, 1839)
big free-tailed bat

Taxonomy

The big free-tailed bat was formerly placed in the genus *Tadarida* and was known as *Tadarida molossa* (e.g., see Durrant 1952, Shuster 1957, Stock 1965, Twente 1960) and as *Tadarida macrotis* (e.g., see Woodbury 1937, Durrant and Behle 1938, Hardy 1941, Barbour and Davis 1969, Hasenyager 1980, Hall 1981). Although almost all authors in recent years have followed Freeman (1981) in recognizing *Nyctinomops* as a genus distinct from *Tadarida*, Hoffmeister (1986) did not.

No subspecies are recognized in this species.

Status in Utah

Distribution

The big free-tailed bat occurs in southern half of Utah, reportedly at least as far north as north-central Utah (Utah County). Since this is a migratory species and is well known to stray to unexpected locations far from its breeding range (e.g., Iowa and British Columbia [Barbour and Davis 1969, Hall 1981]), it is difficult to define its distribution. There is some evidence that it may range as far north as the Wyoming boundary in eastern Utah.

Durrant (1952) had very few Utah records of the big free-tailed bat and wrote that it is "[k]nown only from southwestern and extreme western Utah." Shuster (1957), working with the same material, came to a similar conclusion but suggested that *N. macrotis* may occupy more of Utah than the records indicated. She predicted: "Further collecting may substantiate its presence in Iron, Beaver, Kane, and Garfield counties as well as several possible others within the Great Basin." Barbour and Davis (1969) mapped the distribution of the big free-tailed bat as highly fragmented, with small areas of occurrence in extreme southwestern and extreme west-central Utah as well as in extreme west-central Colorado near the Utah border; they also commented: "[S]ummer records from southwestern Utah suggest a breeding population there." Hasenyager (1980) added records from southeastern Utah (San Juan County) and north-central Utah (Utah County), although the latter location is in need of confirmation. Hall (1981) mapped *N. macrotis* as occurring throughout the southern half of Utah, and his map was followed by Milner et al. (1990).

Bogan and Cryan (2000) reported a specimen of *N. macrotis* from 3 miles west of Jackson, Teton County, Wyoming, which is approximately 103 miles north of the northeast corner of Rich County, Utah. This western Wyoming record may represent wandering, but it is also suggestive of the possibility that this species occurs throughout eastern Utah in proper habitat. High cliffs, such as this bat uses for roosts, are present along many stretches of the Green River in Utah, north (upstream) along its course all the way to the Wyoming border, and may provide suitable roosts for *N. macrotis*. (Moreover, Sherwin [pers. comm.] has detected the big free-tailed bat acoustically in the Flaming Gorge area of Daggett County.)

Wintering Habits

The wintering habits of big free-tailed bats in Utah are unknown. It is presumed that this species migrates out of Utah for the winter.

Twente (1960) placed *N. macrotis* among the bats that are "known to be migratory elsewhere within their geographical ranges and have not been reported from Utah except during the warmer months."

In a report on *N. macrotis* in Utah, which has not been found, Poché discussed wintering habits. According to Hasenyager (1980),

> Poché (1977, unpublished report, Utah Division of Wildlife Resources file) suggests *T. macrotis* is not a year-round resident of Utah. This theory is based on two observations: subcutaneous fat buildup on the lateral and posterior regions of the body were found on specimens captured during the fall; and no observed activity in Utah during the winters of 1974 through 1976.

Abundance

Although a few Utah studies have found the big free-tailed bat to be moderately common relative to other bats, most bat work in this state has shown this species to be one of the rarest in Utah. Barbour and Davis (1969) noted that "[u]ntil the advent of the mist net, *T. macrotis* [= *N. macrotis*] was thought to be very scarce in the United States."

Durrant and Behle (1938) thought that the fact that the 2nd Utah specimen of *N. macrotis* was taken at the same locality as the first (Woodbury 1937) was "suggestive that the species may not be so uncommon in southern Utah as heretofore supposed."

Only 1 (< 0.5%) of the 204 Utah bat specimens examined by Hardy (1941) was *N.*

macrotis, and it was the rarest of the 15 Utah species of which Hardy saw Utah specimens.

Of the 182 bat specimens from Utah examined by Durrant (1952), 3 (1.6%) were the big free-tailed bat; Durrant looked at specimens of 14 bat species (15, if corrected for a later re-identification), and only 1 (or 2, if corrected) of these was represented by fewer specimens.

Shuster (1957) examined 372 bat specimens from Utah; only 2 (0.5%) of these were *N. macrotis*, which ranked 14th of the 15 species of which she looked at specimens.

Hasenyager (1980) compiled records of 23 *N. macrotis* in Utah; of the 18 bat species in his work, this bat ranked 13th in abundance and represented about 2% of his records. Hasenyager (1980) considered *N. macrotis* to be "one of Utah's rarest bats"; however, he mentioned that "[i]n Utah, Poché (1977, unpublished report, Utah Division of Wildlife Resources file) has netted large numbers of big, free-tailed bats", meaning *N. macrotis*. (The referenced report by Poché has not been found.)

Pritchett (no date) and co-workers mist-netted 264 or 265 bats in southern Washington County in1991; 9 (3.4%) of these were big free-tailed bats. *N. macrotis* ranked 7th in abundance among the 10 bat species that they captured, and Pritchett (no date) commented: "It [*N. macrotis*] appears to be locally abundant in Washington County."

Lengas (1994b) mist-netted 220 bats of 9 species in the Ashley National Forest of northern Utah; *N. macrotis* was not represented among his captures.

Of 157 bats of 10 species captured in or near Dugway Proving Ground in Tooele County (Ageiss 1996), none was the big free-tailed bat.

None of the 572 bats of 15 species mist-netted by Mollhagen and Bogan (1997) in the Henry Mountains area was *N. macrotis*.

Only 1 (0.16%) of the 609 bats captured and identified in southern Utah by Jackson and Herder (1997) was a big free-tailed bat; no other bat among the 16 species that they caught was rarer. (They did, however, report acoustic detection of *N. macrotis* at 11 of their 42 study sites.)

Day and Peterson (1999a) mist-netted 640 bats of 13 kinds (13 or 14 species), sampling 28 sites in the Grand Staircase–Escalante National Monument of southern Utah; none of these was *N. macrotis*. Similarly, the big free-tailed bat was not represented among the 179 bats of 10 kinds (10 or 11 species) captured at 15 sites in southwestern Utah by Day and Peterson (1999b).

Habitat

In Utah the big free-tailed bat has been captured in the following habitats: lowland riparian, desert shrub, and montane forest (grass–spruce–aspen). Barbour and Davis (1969) observed: "In spite of its local abundance, this species [*N. macrotis*] is not found in many places where the habitat seems suitable."

As mentioned above, a report on *N. macrotis* in Utah by Poché has not been found. However, Hasenyager (1980) summarized habitat information from this report:

> In Utah, Poché (1977, unpublished report, Utah Division of Wildlife Resources file) has netted … big, free-tailed bats [i.e., big free-tailed bats, *N. macrotis*] over water in desert areas dominated by creosote bush (*Larrea tridentata*), blackbrush (*Coleogyne ramosissima*), sandsage (*Artemisia filifolia*) and snakeweed (*Gutierrezia* spp.). Poché also reported them in riparian habitat of salt cedar (*Tamarix pentandra*), water willow (*Baccharis glutinosa*), rabbitbrush (*Chrysothamnus* spp.) and mesquite (*Prosopis* spp.).

Pritchett (no date) and co-workers mist-netted *N. macrotis* in a warm desert shrub community in southern Washington County.

In southern Utah, Foster et al. (1997) netted the big free-tailed bat in montane forest and woodland characterized by grasses, Engelmann spruce, and quaking aspen.

Jackson and Herder (1997) captured *N. macrotis* in southern Utah in a riparian situation. (Additionally they reported acoustic detection of the big free-tailed bat in riparian habitats, desert shrub, and ponderosa pine forest.)

The lowest reported elevation at which *N. macrotis* has been captured in Utah is 4,297 ft (Stock 1965). However, this species has been captured at several Utah localities that are lower, but the elevations were not mentioned; for example, Hardy (1941) discussed a specimen taken in St. George, which is at 2,880 ft elevation, and both Hasenyager (1980) and Pritchett (no date) recorded *N. macrotis* at Ft. Pearce Wash, which is at 2,700 ft elevation. (Also, Jackson and Herder [1997] reported acoustic detection of this species in southern Utah as low as 2,400 ft.) The highest reported elevation at which the big free-tailed bat has been captured in Utah is 9,200 ft (Foster et al. 1997).

Conservation

Pritchett (no date) wrote:

> We collected nine [*N. macrotis*] at Ft. Pierce [*sic*] Wash in three nights of mist-

netting. Poché deposited twelve specimens in the Museum of Vertebrate Zoology (MVZ), U. C. Berkeley that he collected in 3 nights (MVZ records of Utah mammals). If our netting effort were about the same, we can assume the big free-tailed bat has decreased by 33 percent in the 16 years. We are also assuming he did not release any bats. This bat should continue to be listed as sensitive due to its limited distribution.

In addition to the questionable assumptions upon which this opinion was based, the possibility of sampling error (i.e., too few nights, even if equal in the 2 studies) is great enough that drawing any conclusions concerning decline of *N. macrotis* in Utah or at Ft. Pearce Wash solely from these studies would be premature.

Summary

- Utah subspecies: none
- Utah distribution: s. ½; perhaps n. to Wyoming border in e.
- Utah wintering habits: unknown; presumed to migrate
- Utah abundance: rare, but may be fairly common in some places
- Utah habitats: lowland riparian, desert shrub, montane forest
- Utah roosts: unknown
- Utah elevational range: #2,700 ft to 9,200 ft

Species without Acceptable Documentation in Utah

The following 3 bat species have been reported (or indicated) to be in Utah, and any or all of them may occur in this state. However, none of these species has yet been adequately documented from Utah.

Macrotus californicus Baird, 1858
California leaf-nosed bat

This species is not known to occur in Utah. Durrant (1952) speculated that it may occur in Utah, based on its known occurrence in southern Nevada, and Shuster (1957) and Stock (1965) reiterated this prediction. Later authors (e.g., Hall 1981, Zeveloff 1988) have published distribution maps for this species that indicate its occurrence in Utah but without any substantiating evidence. Apparently these authors were either assuming that Durrant's prediction would be found to be correct or were projecting the hypothetical range, as Hall (1981) stated that he did for all species, beyond localities of known occurrence.

M. californicus has been collected from an abandoned tunnel on the south side of Virgin River at the Virgin Narrows, northeast of Littlefield, Mohave County, Arizona (Hardy 1949), less than 8 miles from the Utah boundary. Some bats fly much greater distances than this in a single night; thus there is reason to believe that individuals of this species may eventually be found in Utah. However, this is a tropical and subtropical species that does not hibernate or migrate, and extended periods of cold temperatures almost certainly limit its distribution. Whether an established, resident, reproducing population of *M. californicus* will ever be discovered in Utah is doubtful.

Myotis velifer (J. A. Allen, 1890)
cave myotis

Miller and Allen (1928) reported 2 specimens of this species, both young, from Thistle Valley, Utah County, and several authors (e.g., Hardy 1941, Durrant 1952, Shuster 1957) have included this bat in the Utah fauna based on this report. Neither Hardy (1941) nor Durrant (1952) questioned this reported record.

Shuster (1957) included *M. velifer* among the bats found in Utah, but with reservations. She expressed doubt concerning its occurrence in Utah for several reasons: (1) The cave myotis had not been collected in Utah since Miller and Allen's report. (2) The specimens were reported to be young, increasing the possibility of

misidentification. (3) The known distribution of the species did not suggest its occurrence in Utah, and especially not central Utah.

Twente (1960) was the first author to reject Miller and Allen's (1928) report of the cave myotis in Utah, saying: "The records of two immature bats from Utah, identified as *Myotis velifer* by Miller and Allen (1928), seem to be of some doubt and are not included ...." Hayward (1970) unequivocally rejected the record, stating: "Two juvenile bats (preserved in alcohol) from Thistle, Utah, were cited by Miller and Allen (1928) as *Myotis velifer*. Upon re-examination, these two specimens proved to be *Myotis lucifugus*."

Of accepted records of *M. velifer*, the nearest to Utah is 6 miles north of Kingman, Mohave County, Arizona (Hoffmeister 1986), which is approximately 120 miles from the Utah border. Whether *M. velifer* ranges north from Arizona into Utah is doubtful, but a locality that is even more improbable than any in Utah would be has been mentioned in a published work. Zeveloff (1988) stated: "There is a report of ... the cave myotis (*Myotis velifer*), from near Idaho Falls [Idaho], but it has not been substantiated." Zeveloff, however, did not provide any details of the Idaho report, such as the source. The locality, Idaho Falls, is 100 miles north of the Utah border and far from the nearest accepted occurrences of *M. velifer* in central Arizona and the extreme southern tip of Nevada.

Cockrum et al. (1996) provided records of the cave myotis from several localities in Mohave County, Arizona, and commented: "The summer distribution of cave myotis is similar to the California leaf-nose bat [*Macrotus californicus*]." Since the latter species is considered to be of potential occurrence in Utah, this raises the question of whether the *M. velifer*, too, potentially occurs in Utah.

Eumops perotis (Schinz, 1821)
western mastiff bat

Jackson and Herder (1997) reported acoustic detection of the western mastiff bat in Utah using an Anabat II ultrasonic bat detector interfaced with a computer. Their acoustic recording was obtained on 10 September 1996 in ponderosa pine forest at Snow's Cabin, Pine Valley Reservoir, Washington County, 6,720 ft elevation. They presented a sonogram (frequency vs. time) of the recorded vocalization in their report (Jackson and Herder 1997) and indicated that identification of the vocalization had been accomplished by comparing it with sonograms provided in a report by O'Farrell (1996). Based on their identification of this vocalization, they declared: "This is the first time the occurrence of this species [*Eumops perotis*] has been documented in

Utah and increases the list of bats found in the state to19." However, others (e.g., O'Farrell, Sherwin, pers. comms.) consider the vocalization recorded by Jackson and Herder (1997) to be that of *Nyctinomops macrotis.*

Published localities, based on specimens of *E. perotis*, that are nearest to Utah are Las Vegas, Clark County, Nevada (Bradley and O'Farrell 1967, Hall 1981) and Secret Pass, west of Kingman, Mohave County, Arizona (Cox 1965, Hall 1981, Hoffmeister 1986, Cockrum et al. 1996). These 2 localities are approximately 83 miles and 158 miles, respectively, from the closest points on the Utah border. The western mastiff bat has also been found at several locations near the Grand Canyon in northern Arizona (O'Farrell, pers. comm.), and some of these locations are not far from the Utah boundary.

Although it is possible that *E. perotis* may yet be found to occur in Utah, there is no persuasive evidence demonstrating its occurrence in this state.

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