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BATS OF THE WHITE AND INYO MOUNTAINS OF CALIFORNIA–NEVADA

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ABSTRACT.—We surveyed bats throughout the White and Inyo Mountains of California and Nevada. From December 1990 to November 1996, we surveyed hibernating bats, and foraging bats from June 1992 to September 1996. The White–Inyo Range rests in a unique biogeographical junction between the Sierra Nevada, Mojave Desert, and Great Basin regions. Elevational gradients of 305–4340 m, combined with limited human development, further enhance the interest of natural history and faunal distributions in this range. We found 13 bat species in the course of 2668 observations. Three of these species, the spotted bat (*Euderma maculatum*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), have no previous records from the White–Inyo Range. We found bats in all vegetation zones except the alpine, 3500–4342 m. Despite an abundance of mines in this range, only Townsend's big-eared bat (*Corynorhinus townsendii*) and the western small-footed myotis (*Myotis ciliolabrum*) used them routinely. Our data also indicated the importance of surface water to bat populations in arid regions.

Key words: bats, Chiroptera, Great Basin, vegetation zones, habitat, desert, arid regions, water source, hibernation.

The White–Inyo Range rests in the junction of 3 faunal regions: the Sierra Province to the west, Mojave to the south, and Great Basin to the east. Because this range rises abruptly on its east and west sides, animals can readily access a variety of vegetation types over short linear distances. In addition to altitudinal differences, vegetation communities are enhanced by a variety of edaphic sites resulting from the range's high lithographic diversity (Elliot-Fisk 1986). Despite this interesting biogeographical setting, faunal distributions of the range have received little attention. Morrison et al. (1993) provided the first thorough study of bird distributions and habitat use in the White–Inyo Range. However, no systematic survey of bats and their habitat associations in these mountains has been undertaken. Hock (1963) summarized results of a handful of general collecting trips from 1917 to 1958 that yielded some bat specimens. This summary plus an unpublished manuscript from a field course at University of California at Davis (Brosius et al. ca 1974) constitute all prior records.

Our objectives were to provide a detailed account of bat distributions throughout the White–Inyo Range, assess how each species utilizes the different vegetation zones available to it along the range's elevational gradient, and characterize how each bat species uses available mine resources. We report observations from both foraging and hibernating bats. Because the White–Inyo Range remains relatively undisturbed habitat, this baseline may prove useful for tracking long-term alterations in environment, since many researchers consider bats to be sensitive indicators of environmental change (Kunz 1982, McCracken 1986, Thomas 1988). These data also provide useful comparisons for other ranges in the region. Thousands of abandoned mines lie on public and private lands (Shields et al. 1995). The importance of these mines as reservoirs for wildlife displaced from natural habitats has gained increasing recognition (Tuttle and Taylor 1994), and documenting patterns of mine use by bats in the White–Inyo Range may prove useful for present and future management efforts.

STUDY AREA

The White and Inyo Mountains extend for approximately 175 km, forming a contiguous range trending north–south and lying just east of and parallel to the Sierra Nevada. The White Mountains comprise the northern half, located within Inyo and Mono counties, California,

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and extending into Esmeralda County, Nevada, on their northern reach. The Inyo Mountains extend to the south and lie entirely within Inyo County, California. Elevational gradients span from 300 m at the eastern base of the Inyo Mountains in Saline Valley, California, to the 4342-m summit of White Mountain Peak, California. Annual precipitation varies from less than 10 cm at the base of the range to approximately 50 cm along the northern crest of the White Mountains (Oglesby 1985, Peterson 1986). The Owens and Chalfant valleys (California) form a continuous valley separating the range from the Sierra on the west, while the east side of the range descends into a series of valleys. From north to south they are Fish Lake Valley, located within California and Nevada, and Deep Springs Valley, Eureka Valley, and Saline Valley, all within California. Although we centered this survey on the White–Inyo Range, to fulfill our goal of assessing elevational range we elected to extend our survey of foraging bats into the valley floors at the base of these mountains. Bats foraging in these areas may depend upon rocky outcrops and other features of the mountains for roosts and hibernaculae.

Five primary vegetation zones occur in the White–Inyo Range along elevational gradients: (1) Mojave mixed desert scrub, characterized by the presence of creosote bush (*Larrea tridentata*), 300–1200 m; (2) Great Basin desert scrub, where shadscale (*Atriplex confertifolia*) is the most common species, 1200–2000 m; (3) pinyon-juniper forest, predominantly singleleaf pinyon (*Pinus monophylla*) interspersed with Utah juniper (*Juniperas osteosperma*), 2000–2900 m; (4) bristlecone–limber pine forest (or subalpine), a mixture of these 2 trees (*Pinus longaeva* and *Pinus flexilis*), 2900–3500 m; and (5) alpine, characterized by the absence of trees, 3500–4342 m.

METHODS

Foraging Bats

We considered bats on the wing from May to October to be foraging. Although active bats are occasionally seen during fair winter weather (Barbour and Davis 1969), these flights may not necessarily be for foraging (Whitaker and Rissler 1989). We surveyed throughout the range in all vegetation zones between June 1992 and September 1996. Although we often could observe bats foraging over open vegetation away from water, we could seldom capture such individuals. Therefore, most of our captures occurred at sources of water that attracted bats (springs, pools, troughs, and stream corridors). We assume these records represent bats observed foraging in the vicinity of those water sources.

Foraging bats were captured over approximately 200 person-days in the field from May through October 1990–1996. We used mist nets or a harp trap set across open flyways near water sources. Four bats recorded in this study were hand-captured from buildings at Deep Springs College, Inyo County, California. We keyed each specimen to species (Ingles 1965, Barbour and Davis 1969, Hall 1981), determined gender (and reproductive status if female), and then released it. We typically maintained the nets from dusk to local 23:30 h depending upon activity, which normally trailed off around 22:30 h. Occasionally, we maintained nets throughout the night but made few additional captures.

Although troublesome to differentiate in other regions, *M. ciliolabrum* and *M. californicus* were readily distinguished in the White–Inyo Range. The White–Inyo *M. ciliolabrum* has a distinctive straw-colored pelage with a highly contrasting dark facial mask and ears. The *M. californicus* we encountered has a chestnut brown pelage with much less contrast to the facial mask and ears (Barbour and Davis 1969, Hall 1981).

We also recorded bats we could identify without capture. In 2 instances, with the aid of binoculars, we identified roosting Brazilian free-tailed bats (*Tadarida brasiliensis*). We then counted individuals as they emerged in the evening. We similarly assessed a colony of pallid bats (*Antrozous pallidus*). The audible calls of the spotted bat (*Euderma maculatum*) enabled species recognition without specialized equipment and supplemented capture records for this species.

Hibernating Bats

We considered inactive bats between the months of November and March to be hibernating. From December 1990 to November 1996, we surveyed 2 natural caves and approximately 260 mines for hibernating bats, working approximately 125 person-days in the field. We entered the mine or cave and visually inspected

all accessible reaches, paying particular attention to crevices in the walls and ceilings. We took care to minimize disturbance to bats and other inhabitants by limiting direct light contact and moving quietly through the mine or cave. Species determinations were made by noncontact inspection to avoid disturbance. Fortunately, all species were identified easily in this way. *M. ciliolabrum* was often found 5–10 cm deep in crevices but was recognizable by its size, pointed tragus, straw-colored fur, and almost black facial mask (Barbour and Davis 1969, Hall 1981). Using a mercury field thermometer ±1°C accuracy, we recorded air temperature in the immediate vicinity of roosting bats.

Previous Capture Records

We searched for previous capture records of White–Inyo bats at the Los Angeles County Museum of Natural History (LACM), Museum of Vertebrate Zoology at Berkeley (MVZ), Western Foundation of Vertebrate Zoology (WFVZ), and among the holdings of the University of California White Mountain Research Station. We included these records in our tabulation of observed species and range distributions.

RESULTS

We encountered a total of 13 bat species from 2668 observations during our survey (Table 1). Three species, *E. maculatum*, silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), were not previously recorded in the White–Inyo Range. The little brown bat (*Myotis lucifugus*) had 1 previous record from this range (LACM); we did not encounter it in our survey (see *Myotis yumanensis* comments in Discussion), although it is known in the nearby Sierra (Hall 1981). *T. brasiliensis*, *E. maculatum*, Townsend's big-eared bat (*Corynorhinus townsendii*), *A. pallidus*, western pipistrelle (*Pipistrellus hesperus*), big brown bat (*Eptesicus fuscus*), long-legged myotis (*Myotis volans*), and western small-footed myotis (*Myotis ciliolabrum*) were all found in both the White and Inyo Mountains portions of the range. *L. noctivagans*, *L. cinereus*, long-eared myotis (*Myotis evotis*), and California myotis (*Myotis californicus*), however, were found only in the White Mountains portion of the combined range. *M. yumanensis* was found only in the Inyo Mountains.

TABLE 1. Compiled observations of bats in the White–Inyo Range, 1990–1997, with previous records shown in parentheses. Previous specimen number for *Myotis volans* is inexact, as it was described as "many" from 3 locations (Museum of Vertebrate Zoology).

Species	Number observed foraging	Number observed hibernating
Tadarida brasiliensis	1185 (5)	—
Euderma maculatum	91*	—
Corynorhinus townsendii	45 (2)	479 (13)
Antrozous pallidus	85 (4)	—
Lasionycteris noctivagans	2	2
Lasiurus cinereus	27	—
Pipistrellus hesperus	410 (18)	4
Eptesicus fuscus	100 (4)	1
Myotis evotis	12 (3)	—
Myotis volans	103 (14+)	1
Myotis californicus	15 (2)	—
Myotis ciliolabrum	33 (4)	49
Myotis lucifugus‡	(1)	—
Myotis yumanensis‡	24 (3)	—
TOTALS	2132 (60+)	536 (13)

*Three captured in mist nets, other records from acoustic detection; see text.
‡We have not listed *M. lucifugus* described by Harris (1974); see text.

We found bats in all vegetation zones except alpine (Fig. 1). The Great Basin desert scrub zone had the highest species richness with 13 species, including the LACM *M. lucifugus* record. Pinyon-juniper was the next richest zone, wherein we recorded 10 species. We recorded 9 species in the Mojave mixed desert scrub zone. We found only 3 species in the bristlecone–limber pine zone; of those 3, only *E. fuscus* and *M. volans* were observed foraging in the zone, whereas *C. townsendii* was recorded hibernating.

The single richest site surveyed was the lower portion of Cottonwood Creek where it enters Fish Lake Valley above the Oasis Ranch on the east side of the White Mountains (T5S R37E, Sec 33; 1600 m elevation). At this site we captured 12 species on separate occasions: *T. brasiliensis*, *E. maculatum*, *C. townsendii*, *A. pallidus*, *L. noctivagans*, *L. cinereus*, *P. hesperus*, *E. fuscus*, *M. volans*, *M. californicus*, *M. ciliolabrum*, and *M. evotis*. The most productive night at this site was 15 August 1995, during which 20 *T. brasiliensis*, 1 *E. maculatum*, 4 *A. pallidus*, 4 *L. cinereus*, 13 *P. hesperus*, 9 *E. fuscus*, 2 *M. volans*, and 1 *M. ciliolabrum* were mist-netted during a 2-h period.

Despite an abundance of carbonate rocks throughout the White–Inyo Range, only 1 cavern is known (2090 m). Located near Westgard

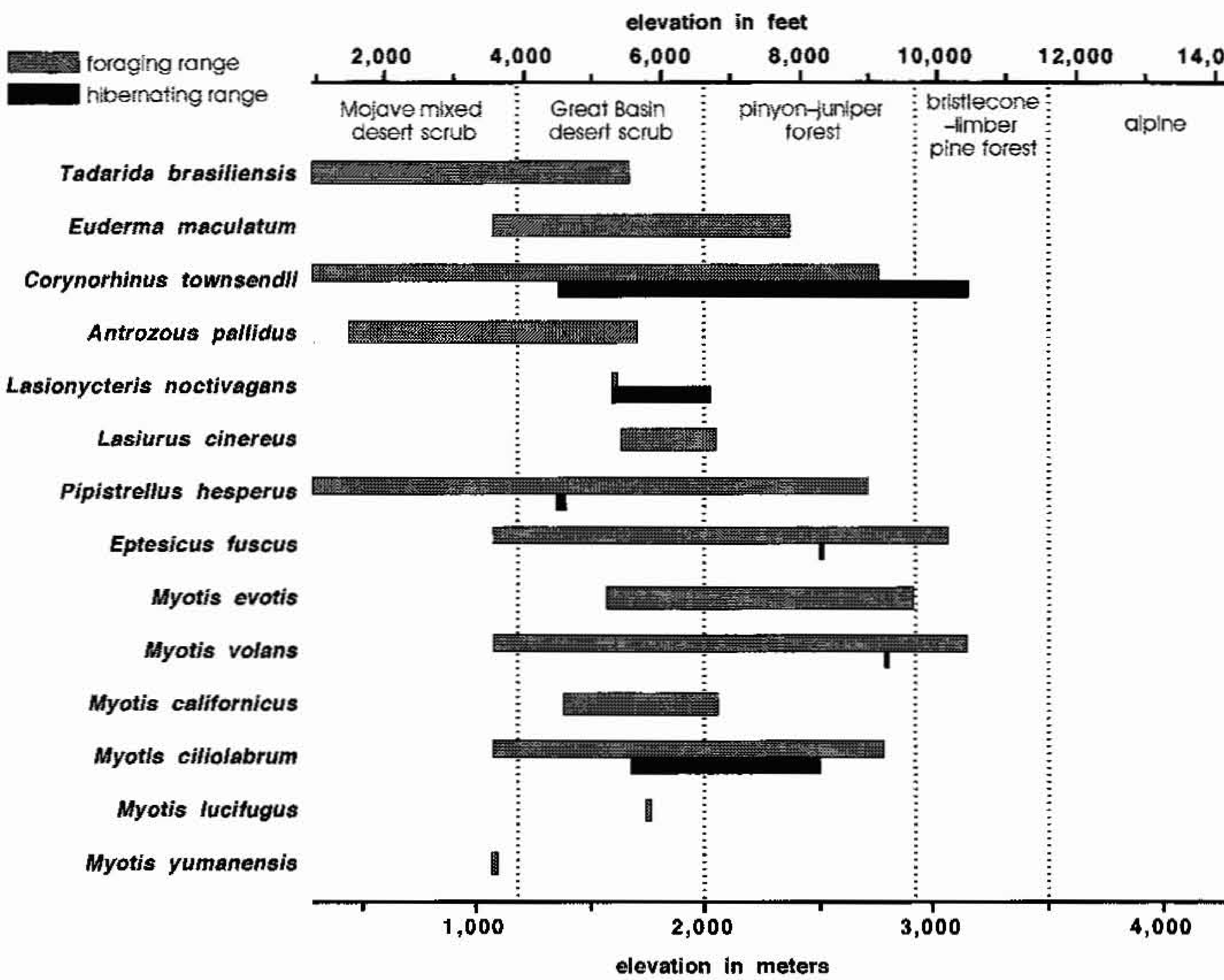

Fig. 1. Elevational distribution of foraging and hibernating bats in the White–Inyo Range showing vegetation zones.

Pass, California, this cavern extends approximately 50 m inward with ceiling heights up to about 25 m. This cavern remains undisturbed because it is protected by a locked gate and remote location and is relatively inaccessible because of its vertical entrance. However, following 4 visits over separate years, we observed only a single *C. townsendii* hibernating within it. A single *C. townsendii* was observed hibernating in a 2-m-deep natural pocket in a dolomite formation in the southern end of the White Mountains (1890 m). On 2 occasions (5 December 1991 and 18 February 1995), an active *L. noctivagans* was found in a dormitory hallway at Deep Springs College. Because of their condition and the dates, we assumed they had been hibernating on the premises. All other hibernation observations were from mines.

We found *C. townsendii* and *M. ciliolabrum* hibernating in mines throughout the range. These species were observed hibernating within about 40 cm of each other. However, we often encountered lone individuals of either species within a mine. We never observed *M. ciliolabrum* hibernating together, but *C. townsendii* were observed in clusters as large as approximately 50 individuals. We observed only 1 individual each of *E. fuscus, L. noctivagans,* and *M. volans* hibernating in mines. In mines below 1500 m, we encountered bats in approximately 25% of mines >3 m in length. Above 1500 m elevation, approximately 50% of mines > 3 m in length contained at least 1 bat. These estimates of mine use are based upon our general impressions only, because it was not possible (or deemed safe) to enter every mine, or to survey every part of the mines we did enter.

Species Accounts

Tadarida brasiliensis

T. brasiliensis was found at the lower elevations of the Inyo Mountains and southernmost portion of the White Mountains (lower Cottonwood Creek, above Oasis Ranch, Mono Co., California; T5S R37E, Sec 33; 1600 m). We

observed a dispersed colony of 1028 at the base of McElvoy Canyon on the east side of the Inyo Mountains, Inyo Co., California (640 m). We describe this colony as "dispersed" because they roost in a series of overhanging ledges along the narrow canyon wall, rather than a single site. A perennial stream flows through the canyon below the roosts. We counted these bats on 26 July 1992 as they flew overhead after emerging, heading in the direction of Saline Valley. This site appears vacant during winter. A crevice in a large boulder above the Deep Springs dairy (Inyo Co., California; T7S R36E, Sec 1; 1590 m) hosts more than 100 *T. brasiliensis* for several weeks during the spring, perhaps a stopover during migration. On 19 August 1996 we found a small colony at the entrance of a dolomite mine at the western base of the Inyo Mountains near the "shoreline" of Owens Dry Lake, Inyo Co., California. We could not determine the number of bats in this colony, but from the limited guano deposit and apparent configuration of the crevice, perhaps no more than several dozen were present.

Euderma maculatum

Three *E. maculatum* were captured along lower Cottonwood Creek on the east side of the White Mountains (Mono Co., California; T5S R37E, Sec 33; 1600 m), 2 males on 17 August 1993 and 1 female on 14 August 1995. Based upon audible calls of this species, we found it to be a common forager among mid-elevation riparian corridors of the range down to the Owens Dry Lake bed (Inyo Co., California; west side of Inyo Mountains, 1080 m). We would typically hear *E. maculatum* from shortly after twilight until the early morning hours. From April through October we routinely heard *E. maculatum* foraging over the fields and buildings of Deep Springs College (Inyo Co., California; T7S R36E, Sec 1; 1600 m). The latest in the year this bat was heard at Deep Springs College was 9 November 1996.

Corynorhinus townsendii

Three foraging *C. townsendii* were captured during this survey, 1 male in Queen Canyon at the northern end of the White Mountains on 9 July 1992 (Esmeralda Co., Nevada; T1N R33E, Sec 32; 2410 m), 1 male at Lower Cottonwood Creek on the east side of the White Mountains on 27 August 1992 (Mono Co., California; T6S R37E, Sec 5; 1600 m), and 1 female on 25 July 1992 at a concrete water trough at the northwest end of Saline Valley Lake at 305 m (Inyo Co., California; T14S R38E, Sec 27). We observed 36 individuals exiting a maternity roost at the base of the White Mountains in Deep Springs Valley (Inyo Co., California; 1705 m), and a single male carcass was found in a building at Oasis Ranch in Fish Lake Valley on the east side of the White Mountains (Mono Co., California; T5S R37E, Sec 28; 1530 m). A maternity colony of several hundred is known on the west side of the White Mountains, Inyo Co., California (1710 m; Patricia Brown-Berry, personal communication). This bat is also known to roost in lava tube caves on the western slope of the Inyo Mountains at approximately 1380 m (Denyse Racine, California Department of Fish and Game, personal communication). The remaining *C. townsendii* observations were of hibernating individuals. Six bats were observed hibernating in a White Mountain mine at 3188 m on 28 November 1992, the highest observation of this survey. The majority of mines we entered during the winter months above 1500 m harbored at least 1 *C. townsendii*. This bat distributed itself well among the available hibernaculae, rather than concentrating within a few selected sites. The 7 largest concentrations observed (per mine) were 80, 51, 40, 25, 25, 20, and 19 bats. The group of 80 was found in the Inyo Mountains at 2140 m elevation with an air temperature near the bats of 5°C on 12 February 1995. The group of 51 was found in the White Mountains at 2400 m elevation and an air temperature near the bats of 4°C on 12 February 1994 (Inyo Co., California). Seven individuals were found in a mine complex on the west side of the White Mountains on 25 February 1993 (Mono Co., California). We observed these bats in a lower adit with an air temperature near them of −3°C.

Antrozous pallidus

We found *A. pallidus* at scattered locations throughout the Inyo Mountains below 1710 m and as low as 430 m at Saline Valley Hot Springs (Inyo Co., California; T13S R39E, Sec 18). Our only observations of this bat in the White Mountains occurred at lower Cottonwood Creek (Mono Co., California; T5S R37E, Sec 33; 1600 m). There is a maternity roost in a side entranceway of the Deep Springs College boarding-

house (Inyo Co., California; 1600 m) from which we counted 39 bats exiting on 5 August 1994. Bats, presumably from this colony, can often be seen night roosting at various sites around the college during the summer. This roost remains vacant during the winter. We captured 1 male and 1 female on 18 June 1996 and another female on 9 July 1996 on the eastern shore of Owens Dry Lake north of the town of Keeler (Inyo Co., California; T16S R38E, Sec 31; 1080 m).

Lasionycteris noctivagans

We captured a male *L. noctivagans* in the White Mountains at the lower Cottonwood Creek site (Mono Co., California; T5S R37E, Sec 33; 1600 m) on 11 June 1996. A female *L. noctivagans* was captured in a dormitory room at Deep Springs College (Inyo Co., California; T7S R36E, Sec 1; 1600 m) on 8 October 1991. On 5 December 1991 we observed an individual hibernating in a drill hole in a mine developed in dolomitic marble on the southern slope of the White Mountains (Inyo Co., California; 2050 m). Another individual was captured in the dormitory wing of Deep Springs College on 18 February 1995. From the condition of this bat and the time of year, it had probably aroused from hibernating on site.

Lasiurus cinereus

We captured 1 female and 3 males at 2090 m along Chiatovich Creek (Esmeralda Co., Nevada; T1S R34E, Sec 29) on 6 July 1992, and 17 females and 7 males at 1590 m along Cottonwood Creek (Mono Co., California; T5S R37E, Sec 33), both on the east side of the White Mountains. Another male was captured on 26 June 1992 along Wyman Creek at 1920 m on the southern reach of the White Mountains (Inyo Co., California; T6S R36E, Sec 22). These drainages all have stands of cottonwood (*Populus fremontii*), a large-leafed tree considered desirable to this tree-roosting species (Barbour and Davis 1969).

Pipistrellus hesperus

P. hesperus is the most common bat we captured in mist nets. Most captures occurred within the 1st hour after sunset. On 26 July 1992 we netted 51 females and 37 males at a pool in McElvoy Canyon on the east side of the Inyo Mountains in 1.5 h (Inyo Co., California; T14S R37E, Sec 1; 790 m). We often observed this species emerging well before dark. Our highest elevation capture was a male on 22 July 1992 at 2740 m in the Inyo Mountains at Mexican Spring (Inyo Co., California; T15S R38E, Sec 34). *P. hesperus* is known to be sporadically active throughout the winter (Barbour and Davis 1969), and we observed it in the late afternoon and early evening flying over and coming down to sip from the hot spring pools in Saline Valley, east of the Inyo Mountains, in February and March 1994 (Inyo Co., California; T13S R39E, Sec 18). Over the course of 7 nights between 6 April 1996 and 18 September 1996, we captured 30 *P. hesperus* over small ponds on the eastern shore of Owens Dry Lake near the town of Keeler (Inyo Co., California; T16S R38E, Sec 31; T17S R38E, Sec 5; T17S R38E, Sec 22; all at 1080 m). Our 4 hibernation observations of this bat occurred at the lowest mines we surveyed (1340–1400 m; Inyo Co., California). Air temperature near the bats in these mines was warmer (15°C) than temperatures we encountered at higher elevations, a situation not ideal for minimizing energy expenditure during torpor, but perhaps conducive to foraging during occasional winter mild spells (Barbour and Davis 1969, O'Farrell and Bradley 1970).

Eptesicus fuscus

We captured *E. fuscus* along the lower sections of perennial streamflows of the White Mountains. All drainages in which we captured this bat were upstream from ranches with established agricultural fields. Hock (1963) listed this bat as occurring up to 3090 m in the White Mountains. Unfortunately, we do not know whether this referred to a hibernating or foraging individual. On 26 June 1993 we found *E. fuscus* foraging along Lone Tree Creek on the west side of the White Mountains at 2070 m (Mono Co., California; T3S R33E, Sec 33). We found a single hibernating bat in a mine tunnel in the White Mountains on 12 February 1994 at 2500 m (Inyo Co., California). A storage shed at Deep Springs College (Inyo Co., California; T7S R36E, Sec 1; 1600 m) serves as a night roost for about 3 dozen of these bats; however, the day roost location for this group remains unknown. On 16 August 1996 we captured a post-lactating female over a small pond on the eastern shore of Owens Dry Lake (Inyo Co., California; T16S R38E, Sec 31; 1080 m).

Myotis evotis

We found *M. evotis* along the lower drainages of the White Mountains and up through the pinyon-juniper zone. Our highest capture for this species occurred on 8 July 1993 at 2470 m along Chiatovich Creek (Esmeralda Co., Nevada; T1S R33E, Sec 35), where we captured 1 male and 1 female; however, the MVZ lists a 1954 record from Cottonwood Creek (White Mountains, Mono Co., California) at 2895 m. A female *M. evotis* was captured beside a storage building at Deep Springs College (Inyo Co., California; T7S R36E, Sec 1; 1600 m) on 4 September 1992. All other captures were at water sites.

Myotis volans

M. volans was well distributed throughout the White–Inyo Range in the Great Basin scrub and pinyon-juniper zones. We observed a single hibernating *M. volans* during this survey in a mine at the north end of the White Mountains on 31 January 1993 (Esmeralda Co., Nevada; 2770 m). Our highest foraging observation of *M. volans* occurred at Mexican Spring toward the southern end of the Inyo Mountains at 2740 m (Inyo Co., California; T15S R38E, Sec 34); however, the MVZ also lists a 1954 record of "many" specimens of this bat from Cottonwood Creek (White Mountains, Mono Co., California) at 2895 m. Our lowest capture of this bat was a male netted on 25 August 1992 at a road stream crossing in Silver Canyon on the west side of the White Mountains at 1410 m (Inyo Co., California; T6S R34E, Sec 24). On 19 June 1996 we captured a nonreproductive female over a small pond on the eastern shore of Owens Dry Lake near the town of Keeler (Inyo Co., California; T17S R38E, Sec 5; 1080 m).

Myotis californicus

We captured *M. californicus* at 4 sites in the White Mountains along its lower slopes in the Great Basin scrub zone and up into the beginning of the pinyon-juniper zone. On 24 July 1995 and 3 August 1995, a female *M. californicus* was found roosting during the day in a classroom at Deep Springs College (Inyo Co., California; T7S R36E, Sec 1; 1600 m). On 25 August 1992 we captured a female at a road stream crossing in Silver Canyon on the west side of the White Mountains (Inyo Co., California; T6S R34E, Sec 24; 1410 m) and 2 males at the Lone Tree Creek headworks (Mono Co., California; T3S R33E, Sec 33; 2070 m), also on the west side of the White Mountains. Three other females were captured along the lower portion of Cottonwood Creek on separate occasions (Mono Co., California; T5S R37E, Sec 33; 1660 m).

Myotis ciliolabrum

Together with *C. townsendii*, *M. ciliolabrum* was the only other bat we commonly found hibernating in the White–Inyo Range. Our highest hibernating observation of *M. ciliolabrum* occurred on 12 February 1994 at 2500 m in the White Mountains (Inyo Co., California), and our lowest was on 23 December 1990 at 1710 m in a small mine on the northwest slope of Deep Springs Valley (Inyo Co., California). We usually found this bat well up into a crevice and hibernating alone, even among a group of tunnels. However, we found 10 distributed through a mine in Marble Canyon on the east side of the Inyo Mountains (Inyo Co., California; 2260 m). We found *M. ciliolabrum* foraging throughout the Great Basin scrub and pinyon-juniper zone of the range. Our highest foraging observation for this species was a male captured at Mexican Spring toward the southern end of the Inyo Mountains on 22 July 1992 at 2740 m (Inyo Co., California; T15S R38E, Sec 34); the lowest was a pregnant female we captured over the runoff of a spring on the eastern shore of Owens Dry Lake (T17S R38E, Sec 9; 1080 m) on 30 May 1996.

Myotis lucifugus

We did not encounter *M. lucifugus* during our survey, but the LACM lists a specimen of *M. lucifugus* from lower Wyman Canyon in the southern White Mountains from May 1972 (Inyo Co., California; T6S R36E, Sec 23; 1740 m). However, we believe a discrepancy exists regarding the *Myotis* species in the Owens Dry Lake area. Our comments in this regard are in the Discussion below.

Myotis yumanensis

We captured 24 specimens of this bat along the eastern shore of Owens Dry Lake on the southern end of the Inyo Mountains. The most prolific activity occurred over a small pond several km north of the town of Keeler (Inyo Co., California; T16S R38E, Sec 31; 1080 m). There we captured 8 lactating females and 1

volant juvenile male on 9 July 1996. At another small pond closer to Keeler, we captured 1 lactating and 1 pregnant female on 19 June 1996 (Inyo Co., California; T17S R38E, Sec 5; 1080 m). These records indicate the presence of a maternity roost in the Keeler vicinity. On 24 August 1995 we netted a female at the Sulfate Well on Owens Dry Lake (Inyo Co., California; T17S R38E, Sec 18) and a male and a female on 14 September 1995 near the eastern Owens Lake margin (Inyo Co., California; T16S R37E, Sec 26). We also observed these bats flying to foraging sites on the lake bed at dusk, presumably heading out from roost sites east of the lake, at the base of the Inyo Mountains.

DISCUSSION

Of the 13 bat species we encountered in this survey, none specialized in any of the 5 vegetation zones of the White–Inyo Range. All species overlapped with at least 1 other zone, although for *L. noctivagans, L. cinereus,* and *M. californicus* the overlap from the Great Basin desert scrub into the pinyon-juniper zone was limited. *E. maculatum, C. townsendii, P. hesperus, E. fuscus,* and *M. volans* were all found foraging over 3 zones. Including the hibernating observations, *C. townsendii* extended its range through all zones in which we observed bats. We observed only *E. fuscus* and *M. volans* foraging in the higher bristlecone–limber pine zone, compared with 9 foraging species in the pinyon-juniper zone. In contrast, Morrison et al. (1993) observed 61 bird species in the bristlecone–limber pine zone, 3 more than in the pinyon-juniper zone. The reduced bat foraging activity in the bristlecone–limber pine zone may result from the diurnal vs. nocturnal habits of birds vs. bats and these bats' exclusive insect diet. The higher elevation of the bristlecone–limber pine zone elicits colder nocturnal temperatures, causing impoverished nocturnal insect activity (Wellington 1945). Graham (1983) found a similar decrease in bat species moving up an elevational gradient in the Peruvian Andes.

C. townsendii foraged in 3 different vegetation communities (Fig. 1). This bat is a known lepidopteran specialist (Barbour and Davis 1969, Clark et al. 1993). While some lepidopteran species may be found throughout these vegetation communities, the overall species composition among these communities most likely differs. Successfully utilizing such different environments as Mojave mixed desert scrub and pinyon-juniper forest suggests an ability to exploit a variety of foraging strategies and prey selection. Such adaptability may seem surprising in view of evidence that this species remains threatened over much of its original range (former C2 species and California species of special concern). However, this result is consistent with other studies indicating that roost disturbance may be a more decisive factor in this bat's decline than habitat disturbance (Pierson and Rainey 1994). The remoteness and low human population density of the White–Inyo Range reduce human disturbance as a factor. However, the remoteness of this range also provides relatively undisturbed foraging habitat; thus, the relative effect of roost vs. habitat disturbance cannot be separated. In fact, the situation in the White–Inyo Range could also be interpreted to suggest that *C. townsendii* requires undisturbed roosts *and* foraging habitat to thrive. Interestingly, the modern White–Inyo population of *C. townsendii* may exceed prehistoric numbers. Humphrey and Kunz (1976) concluded that this bat is a capable colonizer. It naturally roosts in caverns, which rarely occur in this range. Because of this, *C. townsendii* has only recently begun roosting in the area, basically within the many mines created in the last century.

We should note that our survey shows a bias toward activity in riparian corridors and other areas with water, as those were the only places in which we could effectively capture foraging bats. With this bias, the comparative richness we measured in the Great Basin desert scrub zone may instead depict the richness of a wetland environment in the milder climate of this lower elevation zone compared with the others. Thus, it may not accurately reflect general comparative trends in species richness in these zones. Bats typically sip water by skimming over it (Kunz 1982) and thus require water sources with an open surface. We visited point water sources in the Inyo Mountains with such constant bat activity that we did not risk setting mist nets too near them. Because such water sources are the only ones available for many kilometers in any direction, it seems clear that entire populations depend upon these isolated sources. We recommend that wildlife management planners consider the impacts of such

water sources upon bats, in addition to other wildlife. For example, the seemingly harmless cessation of water flow to an old trough may profoundly affect bat populations in a large surrounding area. Evaluation of existing and planned water sources with consideration of bat needs could do much to enhance bat populations in arid regions.

Overall, *C. townsendii* and *M. ciliolabrum* accounted for nearly 99% of all bats found in mines, with *C. townsendii* comprising about 89%. Because both *E. fuscus* and *M. volans* are regarded as regular mine users (Tuttle and Taylor 1994), the single hibernation sightings for these bats contrasted with our foraging observations of these species. This indicated that either their White–Inyo hibernaculae remain undiscovered or they typically leave the area to hibernate. Our observation of *L. noctivagans* hibernating in a mine is of note because this species has rarely been found to use mines as hibernaculae (Barbour and Davis 1969, Altenbach and Pierson 1994).

Noticeably absent from this survey was *M. lucifugus*, whose range is described as encompassing the White–Inyo Range (Hall 1981). Perhaps the sparse timber of the range does not meet the requirements of *M. lucifugus*, which is described as preferring timbered areas (Hall and Kelson 1959). The LACM record from lower Wyman Canyon may be representative of occasional forays this species may make into the White–Inyo Range from the Sierra Nevada to the west. The thoroughness of the present survey would have likely encountered this species if it routinely inhabited the White–Inyo Range.

The Owens Lake myotid that we recorded as *M. yumanensis* is described by Harris (1974) as the subspecies *M. lucifugus relictus*, with Keeler as the type location. However, consistent with earlier descriptions but contrary to Harris, we prefer to maintain its designation as *M. yumanensis* based upon the dull and pale pelage and light-colored ears characteristic of *M. yumanensis*, and our field observations in which its habitat and foraging behavior are more consistent with *M. yumanensis* than with *M. lucifugus*. The Keeler/Owens Dry Lake locale is unforested, an uncharacteristic habitat for *M. lucifugus*. From our observations these bats foraged almost exclusively over the scattered open water along the margin of Owens Dry Lake, flying just over it, a strategy typical of *M. yumanensis* (Barbour and Davis 1969, Herd and Fenton 1983). Harris's conclusion was based solely upon 10 museum specimens, a "few" study skins, and specimens in alcohol. "Few specimens of *M. l. relictus* are undamaged, resulting in a less than ideal sample size for statistical analysis." Harris, noting the pale coloration of the Keeler specimens, accounted for it by stating that "selection at the lower elevations could easily have produced the level of paleness seen at Keeler." Lending further confusion, Harris identified 3 of the 10 Owens Lake museum specimens as *M. yumanensis*. Whatever the taxonomic resolution of this debate, all bats we recorded as *M. yumanensis* are a morphologically similar population. A definitive resolution of the species designation for this population may await DNA analysis.

M. thysanodes (fringed myotis) was also absent from this survey but has a range described to include the White–Inyo Range (Hall 1981). Barbour and Davis (1969) described *M. thysanodes* as preferring pinyon-juniper forests, making their absence from the White–Inyo Range more conspicuous. However, Hall and Kelson (1959) mentioned that it does not seem to be common anywhere in its range and that it seems to prefer caves, which seldom occur in the range. Thus, in contrast to *C. townsendii*, which has apparently moved into the range by exploiting many available mines in place of natural caves, *M. thysanodes* may not be as adaptable to mines or may move more slowly into previously unused areas.

More than a dozen bat species inhabit the White–Inyo Mountain Range, attracted by a variety of natural and artificial conditions. Our data indicate influences in species distribution from vegetation zones, availability of water, and mines. Further work using noncontact census methods will be required to assess the impact of vegetation zones away from water. Today the White–Inyo Range serves as a refuge for bats, and careful management of water, mines, and other resources may continue this role indefinitely.

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