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## Bats of the Colorado oil shale region

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## BATS OF THE COLORADO OIL SHALE REGION

Robert B. Finley, Jr.,<sup>1</sup> William Caire,<sup>2</sup> and Dallas E. Wilhelm<sup>3</sup>

**ABSTRACT.**— New records for *Myotis californicus*, *M. evotis*, *M. leibii*, *M. lucifugus*, *M. thysanodes*, *M. volans*, *M. yumanensis*, *Lasionycteris noctivagans*, *Pipistrellus hesperus*, *Eptesicus fuscus*, *Lasiurus cinereus*, *Plecotus townsendii*, and *Antrozous pallidus* and their habitat occurrence in northwestern Colorado are reported. Mortality of 27 bats of six species trapped in an oil sludge pit is described.

In 1974 the National Fish and Wildlife Laboratory began field work in the Piceance Basin as part of a survey of the vertebrates of the coal and oil shale regions of northwestern Colorado. The information was needed as baseline data in preparation for energy development and to better define the poorly known distribution of mammals in this area.

From the oil shale region of Colorado, roughly defined as Rio Blanco and Garfield counties west of a line between Meeker and Rifle, records of eight species of bats were summarized by Armstrong (1972), seven of which had been reported only from the vicinities of Meeker or Rifle. Since then specimens of five additional species have been collected and numerous locality and habitat records obtained. This information is reported herein to make it available for management decisions, and to facilitate and stimulate further work on the bats of northwestern Colorado.

### STUDY AREA AND METHODS

The elevation of the Oil Shale Region ranges approximately from 1,585 to 2,805 m, falling within the Upper Sonoran, Transition, and Canadian life zones of Cary (1911). The Roan Plateau extends east-west, roughly along the Rio Blanco-Garfield county line, dividing the two main drainages, the Colorado River to the south and the White River to the north. The region is semiarid with predominantly shaly alkaline soils and has only a few long permanent creeks, with many short

intermittent tributaries. The few permanent creek bottoms are occupied by ranches and irrigated hay meadows. Low cliffs and rock ledges border some of the creeks, and high cliffs mark the southern rim of the Roan Plateau and the western rim of the Cathedral Bluffs east of Douglas Creek.

Specimens were obtained primarily by mist-netting and were preserved as study skins and skulls or in liquid. All specimens examined are in the Biological Surveys/Fort Collins collection (BS/FC) of the U.S. Fish and Wildlife Service, unless otherwise indicated: (CU) Colorado University Museum or (KU) Kansas University Museum of Natural History.

### RESULTS

The known kinds of bats from the Colorado oil shale region include seven species of *Myotis* and one species in each of six other genera (*Lasionycteris*, *Pipistrellus*, *Eptesicus*, *Lasiurus*, *Plecotus*, and *Antrozous*). Species found to be most common were the hoary bat (*Lasiurus cinereus cinereus*), long-legged myotis (*Myotis volans interior*), long-eared myotis (*Myotis evotis evotis*), and small-footed myotis (*Myotis leibii melanorhinus*). The spotted bat (*Euderma maculatum*) has been reported in some environmental impact reports as "potentially" or "possibly" present; yet to our knowledge no specimen has been taken in the oil shale region. One was picked up in Browns Park, 65 km north of the oil shale region, in 1981 by J. Creasy (Finley and Creasy 1982).

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## ACCOUNTS OF SPECIES

*Myotis californicus stephensi* Dalquest  
California Myotis

*Specimens examined* (5).—Garfield Co.: 5½ mi N, 2 mi W Rifle, 5,900 ft, 5.

Five California myotis, four unsexed and one female, were found partially decomposed in an oil sludge pit on the east side of the valley of Government Creek north of Rifle. Four specimens were picked up on 17 September 1974 and one on 17 May 1975. They are referred to *stephensi* on geographic grounds. The circumstances of these and 22 other bat casualties at the same sludge pit are described in this paper under "Effects of Energy Development on Bats."

The National Museum of Natural History has a specimen taken 14 August 1907 by Merritt Cary (1911) in a house 7 mi W Rifle, 5,300 feet.

*Myotis evotis evotis* (H. Allen)  
Long-eared Myotis

*Specimens examined* (31).—Garfield Co.: 5½ mi N, 2 mi W Rifle, 5,900 ft, 7; Rio Blanco Co.: Cascade Gulch, T3S, R95W, Sec 8, 1; Duck Cr tank, T1S, R98W, Sec 7, 1; Little Duck Cr, T1S, R98W, Sec 10, 6,200 ft, 10; Ryan Gulch, 24 mi W, 10 mi S Meeker, 6,500 ft, 5; 25 mi W, 10 mi S Meeker, 6,400 ft, 2; 1 mi N, 4 mi W Rio Blanco, 6,900 ft, 5.

Seven long-eared myotis carcasses (1 male, 3 females, and 3 unsexed) were picked up on the bank of the sludge pit north of Rifle on 17 September 1974. This species was the most abundant bat taken at pools adjacent to big sage (*Artemisia tridentata*), greasewood (*Sarcobatus vermiculatus*), and pinyon-juniper habitats. Sandstone ledges or low cliffs were also present within a few hundred yards at all localities.

The most productive mist netting site was on Little Duck Creek, at 2,000 m elevation. There on 7 August 1975 Caire and Finley collected 10 *M. evotis*, 2 *M. leibii*, 4 *M. volans*, 3 *Eptesicus fuscus*, and 2 *Lasiurus cinereus*. The valley bottom was covered with tall, dense big sagebrush and greasewood on deep alluvial soil. Little Duck Creek was entrenched in an arroyo about 3–4½ m deep. The steep upper slopes of the valley were of nearly bare shaly soil. Higher rock outcrops

along the rim supported old mature junipers (*Juniperus osteosperma*).

The water in the arroyo was barely enough to provide a flow, but a deposit of silt at the mouth of a side gully had dammed the flow and formed a long pool about 4 m wide and 20 cm deep. Nets were set over this pool and another about 40 m downstream, where we dammed the stream with a shovel, creating a pool.

One long-eared myotis caught at Little Duck Creek had a large laceration in the left wing membrane, which had fully healed. The study skin (BS/FC 2119), pinned with wings fully extended, has the posterior margin of the membrane between the tibia and the 5th metacarpal deeply concave so that the width (chord) of the left wing measures only 22 mm, compared with 37 mm at the same place on the right wing. A lobe of smooth scar tissue extends anteriorly from the deformed posterior margin, leaving only an 8 mm band of normal membrane between the scar tissue and the radius.

In Ryan Gulch Wilhelm netted bats at a steel stock tank by a windmill on 15 August 1974. He took 5 *M. evotis*, 5 *M. volans*, and 2 *M. leibii*. The terrain and habitat there were almost the same as on Little Duck Creek, except that Ryan Gulch was dry at the time and not so deeply gullied. Less than a mile away in June two macerated skeletons of *M. evotis* that had apparently drowned in a small watering trough were found.

Three of four female *M. evotis* taken on 4 August 1977 on Piceance Creek, 1 mi N, 4 mi W Rio Blanco, were lactating or recently lactating. The habitat there is described in the *M. lucifugus* account. Of the 26 total specimens of long-eared myotis that were sexed, 14 were females and 12 were males.

*Myotis leibii melanorhinus* (Merriam)  
Small-footed Myotis

*Specimens examined* (14).—Garfield Co.: 3 mi N Douglas Pass, 7,000 ft, 1; 4.6 mi W Rifle (by rd), T6S, R94W, Sec 14, 1; 5½ mi N, 2 mi W Rifle, 5,900 ft, 5; Rio Blanco Co.: Cascade Gulch, T3S, R95W, Sec 8, 2; Little Duck Cr, T1S, R98W, Sec 10, 2; Ryan Gulch stock tank, 24 mi W, 10 mi S Meeker, 6,500 ft, 2; Ryan Gulch, 25 mi W, 10 mi S Meeker, 1.

Five *M. leibii* were picked up (4 on 17 September 1974 and 1 on 29 April 1975) on

the bank of the same oil sludge pit north of Rifle where 5 *M. californicus* and 7 *M. evotis* were found. There were 2 females, 1 male, and 2 unsexed carcasses.

This species seems to be found mainly at lower and intermediate elevations in sagebrush, greasewood, and pinyon-juniper habitats, but is less abundant there than *M. evotis*. Our highest record of occurrence was at 2,130 m, 3 mi N Douglas Pass, where one was netted along with *Lasiurus cinereus* on 2 August 1977 over an earthen stock pond. The adjacent hillsides supported mixed chaparral, sagebrush, and grassland with scattered Douglas-fir (*Pseudotsuga menziesii*) and junipers (*Juniperus*).

A female taken on 22 July 1975 at a sheep stock tank 4.6 mi W Rifle contained an embryo 20 mm long. Of the 12 individuals collected that were sexed, half were females. The eight skins at hand show a wide variation in color of the back and sides, from light buffy or reddish brown to dull medium brown, but have uniformly blackish ears and wings.

*Myotis lucifugus carissima* Thomas  
Little Brown Bat

*Specimens examined* (3).— Garfield Co.: 4 mi W, 1 mi S Rifle, 5,300 ft, 1; 1 mi N, 4 mi W Rio Blanco, 6,900 ft 2.

A female was taken on 28 August 1975 over a sheep watering pond in the Colorado River valley west of Rifle. The pond had been bulldozed in alkali soil on a greasewood flat south of cliffs and a steep rock slope with pinyon-juniper.

Two males were taken in a net across upper Piceance Creek west of Rio Blanco on 4 August 1977. At that point the valley is narrow between steep canyon sides covered with pinyon-juniper and mountain shrub, with Douglas-fir in the tributary gulches. The valley bottom was grazed by sheep, and the creek was barely flowing between long shallow pools. Other bats taken there were four *M. evotis* and one *Lasionycteris*.

Cary (1911:206) collected two *M. lucifugus* on the White River meadows a few miles east of Meeker in August 1905.

*Myotis thysanodes thysanodes* Miller  
Fringed Myotis

*Specimens examined* (1).— Rio Blanco Co.: 11 mi W Meeker, ½ mi S Hwy 64, Hay Gulch Rd, 1 (CU).

A male fringed myotis was netted by Jerry Freeman on 17 August 1978 at a stock tank where Hay Gulch opens into the White River Valley.

*Myotis volans interior* Miller  
Long-legged Myotis

*Specimens examined* (14).— Garfield Co.: 2 mi E Rio Blanco, 1; Rio Blanco Co.: Little Duck Cr, T1S, R98W, Sec 10, 4; Little Hills Game Research Station, 15 mi W, 1.9 mi S Meeker, 4 (CU); Ryan Gulch, 24 mi W, 10 mi S Meeker, 5,600 ft, 5.

*Myotis volans* occurs in the sagebrush, greasewood, and pinyon-juniper habitats along with *M. evotis* and *M. leibii*. Specimens were taken at sites described under the accounts of these species, and also at a more wooded site described under *Lasiurus cinereus*.

Two males and two females were taken in the barn at the headquarters of the Little Hills Game Research Station by Bissell, Olivas, and Webb of the Colorado Division of Wildlife on 29 June and 7 July 1977. The barn is in a gulch flanked by rocky slopes with pinyon-juniper. One *M. yumanensis* and one *Eptesicus fuscus* were also obtained there.

Eight of the 14 *M. volans* examined were males and 6 were females.

*Myotis yumanensis yumanensis* (H. Allen)  
Yuma Myotis

*Specimens examined* (4).— Rio Blanco Co.: Little Hills Game Research Station, 15 mi W, 1.9 mi S Meeker, 1 (CU); Rio Blanco Lake, 3 (CU).

Three female Yuma myotis were taken on 6 and 7 July 1977 by Ribic and Olivas in the attic of a deserted house by Rio Blanco Lake, a small reservoir on the White River near the mouth of Piceance Creek. One contained three embryos 4 mm in length.

*Lasionycteris noctivagans* (Le Conte)  
Silver-haired Bat

*Specimens examined* (8).— Garfield Co.: 5½ mi N, 2 mi W Rifle, 5,900 ft, 6; Rio Blanco Co.: 3½ mi W Rio Blanco, 1; 1 mi N, 4 mi W Rio Blanco, 6,900 ft, 1.

Six silver-haired bats (5 males and 1 female) were found at the sludge pit north of Rifle. One each day was picked up in a fairly good state of preservation on 29 April, 14 May, and 17 May, two on 4 June 1975, and one still alive on 17 September 1974.

Only two *Lasionycteris* were taken in mist nets, one each at two sites on Piceance Creek west of Rio Blanco, where they were associated with *M. lucifugus* at one site and *Lasiurus cinereus* at the other. The sites are described under those accounts.

*Pipistrellus hesperus hesperus* (H. Allen)  
Western Pipistrelle

*Specimens examined* (2).—Garfield Co.: 5½ mi N, 2 mi W Rifle, 5,900 ft, 1; 4 mi W, 1 mi S Rifle, 5,300 ft, 1.

One *P. hesperus* was picked up on 17 September 1974 at the sludge pit north of Rifle. The only pipistrelle netted was in the Colorado River valley at the locality described under *M. lucifugus*. These records and the absence of specimens from our other sites at higher elevations bear out Cary's (1911:209) statement that pipistrelles "inhabit the Upper Sonoran zone in the western and southwestern valleys . . . [and] live only about cliffs and in rock-walled canyons."

*Eptesicus fuscus pallidus* Young  
Big Brown Bat

*Specimens examined* (4).—Rio Blanco Co.: Little Duck Cr, T1S, R98W, Sec 10, 6,200 ft, 3; Little Hills Game Research Station, 15 mi W, 1.9 mi S Meeker, 1 (CU).

One big brown bat was shot flying over tall sagebrush and two were netted over a pool in a gully at Little Duck Creek on 7 August 1975. The habitat and other captures are described under the account of *Myotis evotis*. Cary (1911:209) obtained a big-brown bat from the White River, a few kilometers east of Meeker in August 1905.

The four skins vary in color, as discussed by Armstrong (1972:70), and fall within the range of a series of nine *pallidus* in the BS/FC collection from 5 mi E, 1 mi N Fort Collins, except that one is more light reddish than any in the Fort Collins series.

*Lasiurus cinereus cinereus*  
Palisot de Beauvois  
Hoary Bat

*Specimens examined* (16).—Garfield Co.: 3 mi N Douglas Pass, 7,000 ft, 1; 3.4 mi N Rifle, on Government Creek, 1; 5½ mi N, 2 mi W Rifle, 5,900 ft, 3; 2 mi E Rio Blanco, 7,500 ft, 3; Rio Blanco Co.: Little Duck Cr, T1S, R98W, Sec 10, 2; T1N, R102W, Sec 4, W of Rangely [5,300 ft], 1; 3½ mi W Rio Blanco, 5.

The hoary bat was the most abundant species in mist nets set over pools of Piceance Creek adjacent to cottonwood (*Populus*) and Douglas-fir stands between 2,000 and 2,300 m elevation. One was also netted over an ephemeral pond a few miles west of Rangely in salt desert shrub at 1,615 m elevation. Three hoary bats were picked up at the sludge pit north of Rifle. A female was found on 15 July 1974 and a male and a female on 17 September 1979. Two male hoary bats were netted on Little Duck Creek on 7 August 1975 at the site described under the account of *Myotis evotis*.

Five male hoary bats were caught in two nets over Piceance Creek, 3½ mi W Rio Blanco, on the night of 10–11 July 1975. One net was set over a narrow beaver pond in a grove of cottonwoods and the other in a grassy area just below the junction of Cow Creek and Piceance Creek. The Piceance valley was narrow between steep hillsides wooded with small Douglas-fir and mixed mountain shrubs on the shady side and mostly pinyon-juniper on the sunny slope.

One female and two male hoary bats, as well as one female *M. volans*, were netted on 10–11 July 1975 over a beaver pond on upper Piceance Creek, 2 mi E Rio Blanco, 7,300 ft. The site was more wooded than the one just described (3½ mi W Rio Blanco). The north-facing slope above the beaver pond was covered with Douglas-fir, and the opposite slope had a heavy stand of pinyon-juniper and mountain mahogany (*Cercocarpus montanus*). Other localities where hoary bats were taken are described under the accounts of *Myotis leibii* and *Antrozous pallidus*.

A pregnant female (BSC/FC 5109, alcoholic) was taken on 11 July 1975, 2 mi E Rio Blanco. She weighed 30 grams and carried two embryos, 22 mm. All 11 of the other

hoary bats taken by mist nets were males. The 11 skins available vary considerably in appearance. The three taken the latest in the summer (7 August) have longer dorsal fur with a heavier overlay of silver tips. Some taken in July have short pelage and some are moulting.

*Plecotus townsendii pallescens* (Miller)

Townsend's Big-eared Bat

*Specimens examined* (5).—Rio Blanco Co.: Spring Cave, 7,850 ft, 9 mi S, 4 mi E Buford, 4; 5 mi N, 10 mi W Rangely, 5,800 ft, 1 (KU).

On 19 February 1977 Finley visited Spring Cave to investigate reports of two kinds of bats there in winter, one with "long" ears and one with "short" ears. This limestone cave is located high on a forested mountain-side in the White River National Forest. A detailed description, photos, and maps of Spring Cave were published by Parris (1973:221). The mountainside was snow covered, but temperatures were mild. There were a few scattered dormant bats on the wall of the entry passage between the two main entrances, some even in the twilight zone. There were about 90 bats in all high on the wall of the "Long Room" extending southwest from the entry passage. About 25 were hanging singly and about 65 in 3 clusters, mostly 2 to 3.7 m above the floor. All appeared to be *Plecotus*, some with ears extended and some with ears folded, giving a first impression of two kinds of bats present. No bats were seen beyond the bend in the Long Room or on the walls of the "Tunnel" or "Pirates' Den." Wilhelm visited Spring Cave on 15 August 1974 and explored it without finding any bats or guano deposits. Armstrong (1972) reported one specimen at the University of Colorado Museum from Spring Cave.

A single male big-eared bat was taken by Finley on 29 August 1948 in a sandstone cave 5 mi N, 10 mi W Rangely, 5,800 ft., Rio Blanco County. It was found in an overhead vertical cleft through the roof of an arched rock shelter that was also occupied by a bushy-tailed wood rat (*Neotoma cinerea arizonae*).

*Antrozous pallidus pallidus* (Le Conte)

Pallid Bat

*Specimens examined* (4).—Garfield Co.: 3.4 mi N Rifle, on Government Cr, 3; Rio Blanco Co.: T1N, R102W, Sec 4, W of Rangely, 1.

Three pallid bats, lactating females, were taken by Caire on 25 July 1975 in a net set under cottonwoods over a trickle of water in Government Creek north of Rifle. The creek was nearly dry and lined with large cottonwoods and a few tamarisks (*Tamarix gallica*). On 7 August 1975 another lactating female was taken west of Rangely on the dry, low sage-saltbush bench south of the White River. The net was set across the lower end of a shallow, mud-flat pool in a small arroyo. A single hoary bat was the only bat taken in the evening, and the pallid bat was found in the net the following morning.

Cary (1911:206) reported seeing a pallid bat "among the cliffs along the Grand [Colorado] River, 7 miles west of Rifle, August 14, 1907."

EFFECTS OF ENERGY DEVELOPMENT  
ON BATS

Man's increasing activities for development of energy resources in western Colorado can entail several kinds of adverse effects on bat populations, such as disturbance of hibernating bats in caves, mine tunnels, and other sites; destruction of daytime roost sites; loss or contamination of watering sites; and contamination of the food chain by insecticides and pollutants.

Bats are extremely vulnerable because of their specializations as volant, nocturnal insectivores. For protection against ground predators they require secure daytime roosts such as cave walls, cliff crevices, or hollow tree snags. Suitable shelters in the oil shale region are usually located in narrow canyons and ravines or on juniper-covered rimrock. Such terrain features occupy a low percentage of total land area and should be avoided as waste disposal sites for spent shale from retorts.

Both natural and man-made water surfaces are widely available to bats for drinking in northwestern Colorado. The main permanent streams such as the White River and Piceance Creek are important and likely to

remain dependable drinking sites. But the small intermittent streams and springs are very susceptible to loss by lowering water tables when wells are drilled, and may become contaminated by waste dumping or spillage. Loss of springs and small stream pools on the upland areas may be compensated for by presence or addition of stock-watering tanks. As long as cattle raising is maintained as a viable industry in the areas of energy development, the adverse effects on bats of spring and creek flow loss can be at least partially mitigated. However, production of aquatic insect food would still be reduced.

Drilling for oil and gas in Colorado results in a certain amount of drilling fluids and oil at well sites being spilled and impounded in pools or sludge pits. These are recognized hazards to birds and other wildlife, but bats have not previously been reported as casualties. A source of bat mortality was called to our attention by Richard E. Pillmore, who picked up a mummified hoary bat carcass on 15 July 1974 on the bank of a sludge pit 5½ mi N, 2 mi W Rifle at 1,800 m elevation. Pioneer Drilling, Inc., had drilled a test well and dug two pits for impounding spilled oil. The sludge pool was situated in the bottom of a pit with steep banks rising about 3 m above the surface, which was about 23 by 30 m in size. Oil in the pool formed a thin slick over the water, which was a few feet deep. This lower pool was formed by drainage from an adjacent higher pit that contained much heavier oil sludge and was nearly dried up. The oil well and pits were on a bulldozed pad of alkaline clay soil on the east side of the valley. The pad was surrounded by a gentle slope covered with greasewood. To the east was a steep rocky slope of pinyon-juniper, leading up to high cliffs bounding the east side of the valley of Government Creek.

The lower of the two sludge pits proved to be a lucrative source of bats. They were found 3 to 8 m from the edge of the lower pool, but none were found around the upper, nearly dry pit. In the following 16 months repeated visits to this site by Finley and others yielded 27 poor-quality but identifiable specimens. The kinds and numbers of individuals collected are as follows: hoary bat (3), long-

eared myotis (7), small-footed myotis (5), California myotis (5), western pipistrelle (1), silver-haired bat (6).

A live, oil-soaked *Lasionycteris* was seen on 17 September 1974 hanging on the side of a rock about 1 m from the oil-slick surface of the pond. It responded to touch but did not seem to be much affected by the oil.

In comparison with collections from other localities, there were relatively high numbers of silver-haired bats, only two of which have been taken by mist net in the region, and of California myotis, none of which has been mist-netted; but the pallid bat, three of which were netted only 5 km away, is absent from the sludge pit sample. A more common species not far away, *Myotis volans*, was also absent from the sludge pit. Perhaps various species of bats differ in their vulnerability to entrapment.

On 19 September 1974 Finley visited the Rangely oil field and inspected sludge pits without finding any bats. The six pits that contained oil were all much smaller than the pit north of Rifle and had heavy oil, apparently without water, in the bottom. They had wires with colored streamers stretched over them, apparently to keep out birds. It does not seem likely that bats would mistake such pits for water ponds. Four sludge pits containing oil on water were inspected on 1 May 1981 between Craig, Colorado, and Rock Springs, Wyoming, without finding any bats.

Three instances of entrapment of bats in oil are known to us in the literature: Krutzsch (1948) described finding 3 bats as well as insects, lizards, and birds in three small pools of oil formed by drainage into a gully from a recently oiled road in the Borego Desert, California. Barbour and Davis (1969) cited a report by E. J. Koestner of 15 red bats (*Lasiurus borealis*) entrapped in oil on a 500-foot stretch of road in Illinois. Gillette and Kimbrough (1970) reported a bat seen in a "tar pit" of undescribed origin at Fort Sill, Lawton, Oklahoma.

We thank Jerry Freeman for permission to report a specimen of *Myotis thysanodes* taken by him, Michael Bogan for identifying several bats, and the Colorado Division of Wildlife for generous information and assistance.

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