# Assessment of Abandoned Mines for Bat Use on Bureau of Land Management Lands in Southwestern Montana: 1997-1998

Submitted to the
Biological Resources Division,
Midcontinent Ecological Science Center
and
Bureau of Land Management,
Dillon Field Office

Paul Hendricks
David Kampwerth
Michelle Brown

November, 1999

MONTANA
Natural Heritage
Program

This document should be cited as follows:

Hendricks, P, D. Kampwerth, and M. Brown. 1999. Assessment of abandoned mines for bat use on Bureau of Land Management lands in southwestern Montana: 1997-1998. Montana Natural Heritage Program. Helena, MT. 29 pp.

## ABSTRACT

One hundred and seventy-three abandoned mine workings (77 adits, 96 "shafts" and pits) at 88 mine sites in southwestern Montana (Beaverhead, Madison, and Silver Bow counties) were investigated for evidence of use by bats during 1997-1998. Of the mine workings, 40 (23.1%) were partly or completely collapsed. Evidence of bat use was collected from 66 workings at 49 mine sites. Bat activity was detected with ultrasonic bat detectors or trapping at 61 workings of 45 mine sites. Bat guano (usually only one or a few droppings) was present at 5 additional mine workings at 4 mine sites where there was no other evidence of bat use. No maternity sites were found (although single lactating females were captured twice at one mine); the majority of used workings were probably night roosts. Only one working was confirmed as a hibernaculum, but several others may be so used.

Sixty-four individuals represented by Western Small-footed Myotis (*Myotis ciliolabrum*), Western Long-eared Myotis (*M. evotis*), Big Brown Bat (*Eptesicus fuscus*), and Townsend's Big-eared Bat (*Corynorhinus townsendii*), were captured or observed at 17, 5, 2, and 3 mine workings, respectively. Sex ratio of captured bats was extremely male biased. Most bat detector results (at 47 of 50 workings with detections) were identified as unknown bat or unknown *Myotis*, but species identifications were tentatively assigned to *M. evotis* at 10 workings, *E. fuscus* at 12 workings, *C. townsendii* at 6 workings, and *Lasionycteris noctivagans*/*Lasiurus cinereus* at 4 workings.

Monitored mines at higher elevations were used less often than mines below 6000'. Unobstructed mine workings were used more often than workings with partial obstructions, and adits in both categories were used more often by bats than were shafts. The elevation distributions of monitored adits and shafts were similar, and therefore not a factor confounding the general elevation pattern of use. Dominant vegetation at most (87%) of the monitored workings was sagebrush shrubland, and was also not a confounding factor in the detected patterns of mine use. Neither portal size nor the number of open portals at a mine site appeared to affect use by bats. Proximity to water could not be accurately determined, but most workings were < 2 km from known surface water, which is probably within the nightly foraging range of most bats.

Twelve mine workings were inspected internally for the presence of bats. Mines chosen for entry were selected based on relative hazard and prior evidence of bat use. Bats (four total) were found in three mines. Data loggers were installed in six mine workings to record over-winter mine air temperature and relative humidity every six hours. Data logger results are not included in this report, but will be provided as an addendum. Climate data taken at the time of entry indicate most sites probably are too cold for maternity colonies.

It is recommended that all open workings be considered as potential habitat for bats in this area. None of the workings where bat activity was confirmed should be closed, although monetary considerations could limit the number of workings modified to protect bats while restricting access to humans. Instead, other protective and bat-friendly measures should be considered, such as the installation of gates. Highest priority sites are those confirmed, or with the potential, to be maternity and/or hibernation roosts. The current method for closing shafts and other "vertical" workings (ground-level grating with 1x3 inch openings) effectively prohibits access by bats. Replacement of fine-meshed grates with an alternative, bat-friendly design might allow bats to use a number of these workings.

**TABLE OF CONTENTS**

## ACKNOWLEDGMENTS

This project had its origins in the fertile minds of Dave Genter (MTNHP) and Tom O'Shea (BRD/USGS). Without their initial planning and design efforts in coordination with DK the project wouldn't have seen the light of day. In the early stages (1997) Pete Feigley supervised and fine-tuned the project, both in the office and the field, with the help of MB and Sam Martinez. External field surveys were conducted in 1998 by PH, Tom O'Shea, MB, and Janelle Corn; the bulk of the work was carried out by the latter two individuals. Internal surveys were conducted by PH, DK (who also organized the safety protocols for the project), Sam Martinez, MB, and Tom O'Shea. Robin McCulloch (Montana Bureau of Mines and Geology) provided an MSHA training session for those of us scheduled to go underground. John Hinshaw (MTNHP) corrected the GPS data we brought to him, Kate Schletz (MTNHP) interpreted bat calls recorded on cassette tapes at surveyed mines. Tom O'Shea provided numerous suggestions on an earlier draft of this report that significantly improved its content. The project was funded through Cooperative Agreement No. 1434-CR-97-AG-00008 between the USGS-Biological Resources Division, Midcontinent Ecological Science Center and the Montana Natural Heritage Program, under the USGS Species-At-Risk program.

## INTRODUCTION

Several species of North American cave-dwelling bats have been adversely affected in recent decades by a variety of human-induced environmental changes to caves, including cave closures, impoundments, and vandalism or other direct human disturbances (see Humphrey 1978, Tuttle 1979, LaVal and LaVal 1980, Sheffield et al. 1992.). These, and landscape changes such as deforestation (including loss of large trees with basal hollows) and agricultural development, have forced many bat species to abandon traditional sites in search of new roosts and hibernacula. As a result of these wide-spread disturbances, some cave-dwelling species in the eastern and Midwestern United States have been listed as threatened or endangered under the U.S. Endangered Species Act. Abandoned mines offer a variety of subterranean microclimates similar to those in natural caves (Tuttle and Stevenson 1978, Tuttle and Taylor 1994) and can provide suitable habitat for roosting and hibernating bats. Abandoned mines now serve as principle roosts and hibernacula for many cave-dwelling species (Tuttle and Taylor 1994), and are important for populations occupying marginal habitats (Gates et al. 1984) in areas where there are continued threats to primary natural roosts. It is widely acknowledged that natural cave environments are the most stable and desirable long-term habitats for bats, but abandoned mines may provide a suitable alternative.

Mine reclamation (including closure to restrict human access) is of interest to wildlife managers because reclamation activities can have significant negative impacts on bat populations (see Sheffield et al. 1992, Richter et al. 1993). Therefore, it is important that closure is done in such a way as to minimize disturbance to bats in the mines affected. Because the majority of bat species in Montana use caves and mines, it is especially important to determine the extent and magnitude of mine use by bats in the state, and identify situations where access by humans to abandoned mines can be restricted while maintaining mine attractiveness to bats.

Increased concern over bat populations nationally, coupled with increased emphasis on the closure of abandoned mines on public lands, has prompted Bureau of Land Management (BLM) biologists in Montana to assess abandoned mines for bat activity prior to mine closure (e.g., Hendricks 1997). A number of abandoned mines on BLM land in southwestern Montana are scheduled for closure in the near future. Some of these mines may provide habitat critical for hibernation, reproduction, and warm-season roosting by bats, including Townsend's Big-eared Bat (*Corynorhinus townsendii*), a designated Special Status species by the BLM in Montana, identified as a high priority species in 1998 by the Western Bat Working Group, and designated as a species of concern (former C-2 candidate for listing) by the U.S. Fish and Wildlife Service.

Primary objectives of the 1997-1998 abandoned mine inventory on BLM lands in southwestern Montana were to 1) identify specific mine workings used by bats, 2) gather external mine attribute data that might aid in identifying the suitability of unsurveyed workings and predicting broader patterns of mine use, 3) gather internal mine attribute data that will provide baseline environmental information on abandoned mines used by bats, with the expectation that these data will be useful in identifying suitable mine workings, even in the absence of bats, and 4) capture and identify bat species using abandoned mines in the project area.

## STUDY AREA AND METHODS

The study area is in the Beaverhead Section ecological unit of the U.S. Forest Service Northern Region (Nesser et al. 1997). This section has a cold continental climate characterized by a warm, dry summer and a cold, dry winter; mean annual precipitation ranges from 9-20 inches (23-51 cm), with about 10% falling as snow. Large gravel filled valleys, surrounded by steep fault block mountains of a variety of bedrock types, dominate the topography. Valley elevation ranges from 4700-7600 feet, potential natural vegetation is largely sagebrush-steppe. The majority of mines surveyed were in this Southwest Montana Intermontane Basins and Valleys subsection.

Lists and location of mine sites and workings to be visited were obtained from the Dillon and Headwaters Resource Areas – BLM (= Dillon and Butte Field Offices, respectively), from databases developed by the Montana Bureau of Mines and Geology, and directly from topographic maps. Areas of focus tended to be at and near mines on the BLM lists, and particularly in mining districts (Ermont, Rochester, Tidal Wave) scheduled first for mine reclamation activities. The majority of mine workings surveyed were located in southwestern Montana, in Beaverhead and Madison counties, with a handful of sites in extreme southern Silver Bow County.

Precise location of 52 sites was recorded on a differentially-correctable Trimble Geoexplorer II GPS unit, but some sites were never recorded and some files were inadvertently lost. Thus the record of GPS locations in Table 1 is incomplete because of missing data, and the production of maps from the available data seemed pointless. Nevertheless, all mines surveyed were recorded to quarter-quarter section precision (see Table 1), and photographs, where taken, were filed for future reference with original field data sheets at the Montana Natural Heritage Program Helena office.

Mine workings represent a continuum of types, but were classified into three basic categories: adits (horizontal slender workings), shafts (vertical slender workings), and pits (vertical broad workings). Some workings fell somewhere between adits and shafts, and are more accurately termed "inclines"; inclines usually appear on topographic maps (if portrayed at all) as shafts. Most often, inclined workings were angled > 30°, and contained remains of ladders in the main passage to aid movement. In this report inclined workings steep enough for ladders to be helpful are categorized as shafts and those of lesser angle are termed adits, for reasons of simplicity and lack of clear criteria for demarcation between adits, inclines, and shafts.

For each mine site visited, the presence or absence of open portals was the first variable noted. If a mine working had not collapsed, then the dimensions of each opening were measured or estimated, any obstructions (grating, cable netting, fallen timbers or rock, etc.) noted, and if accessible the entrance was inspected for bat spoor (primarily droppings). Temperature of outward air flow, if present, was also measured. Dominant cover-type of the surrounding habitat at mines was classified following a standardized scheme used by Montana Partners-In-Flight for point-count monitoring of birds (Hutto and Young 1999).

A small subset of mine workings was examined internally for bats and to install electronic data loggers (HOBO; Onset Computer Corporation, Bourne, MA). Data loggers were set to record mine air temperature and relative humidity every 6 h, put in the selected mines in September 1998, and left in situ during winter 1998-1999. The underground climate data captured by the data loggers are not available for this report. Underground workings were crudely mapped as far as they were examined, and carefully inspected for bats and bat guano in sections deemed safe to explore. Twelve workings were thus examined (Table 1), and data loggers were left in six of these.

Bat detectors (ANABAT II; Titley Electronics, Ballina, Australia), mist nets, and/or harp traps were deployed at workings where spoor was present or the mine working otherwise appeared potentially suitable for bats. Detector units (consisting of an ultrasound detector, timer/tape-driver, and a voice-activated cassette tape recorder) were set before dusk facing portals or aimed across shafts, and left in place overnight. Recorded calls were analyzed on an IBM compatible PC using ANABAT II zero-crossings analysis interface module (ZCAIM) and software.

Assignment of vocalizations to a particular species of bat was achieved by matching time-frequency structure of field recordings with a reference set of calls obtained from captured individuals and published descriptions of vocalizations (e.g., Fenton et al. 1983, O'Farrell 1997) However, bat species can show significant variation in call structure (Betts 1998, Barclay 1999), and we did not actively track and record flying bats (O'Farrell et al. 1999) to maximize quality and quantity of diagnostic sequences. Furthermore, units recorded bats exiting roosts or flying near potential roosts. Roost-exit calls and calls in high clutter tend to be fragmentary, lacking diagnostic features necessary for species identification (O'Farrell 1999). Therefore, all species-level identifications based on recorded vocalizations, where made in this study, are considered tentative.

*Myotis* designations (as a group) were assigned to recordings with vocalizations of short duration (< 3 msec) with a relatively linear, perpendicular call pattern. In some cases, *Myotis* call sequences were assigned to *M. evotis* if sweep pattern ranged from a maximum 90 kHz to a minimum 35-40 kHz, otherwise all were classified *Myotis* species Calls with a bilinear (extreme curvilinear) pattern were tentatively assigned to a non-*Myotis* species or classified as unknown bat. Passes with call fragments were also designated unknown bat if no associated calls allowed finer resolution. Most bilinear call sequences were assigned to *Eptesicus fuscus* if a continuous frequency tail ranged from 33-28 kHz. This could result in confusion with *Lasionycteris noctivagans* (Betts 1998), which has a similar call structure, but most of our recordings were made at the mouths of mines where the latter species is unlikely to occur.

Number of "passes" (defined here as a distinct vocalization with at least a 1 sec gap between prior and following vocalizations) was recorded as a measure of relative activity at each site. At five sites with bat activity, equipment malfunctioned prematurely. Therefore, relative activity as presented here is useful primarily as an index with variable degrees of error.

Bats were captured using 50-denier mist nets of various lengths (most often 6 and 9 meter) and set in a variety of arrays across portals, depending on site morphology. Nets typically were operated for at least three hours (usually until midnight or 01:00 MDT). Less frequently a harp trap was set in the portal of an adit and left overnight. Captured bats were identified with aid of keys in van Zyll de Jong (1985) or Nagorsen and Brigham (1993). Individuals were sexed, aged, measured (forearm, weight), reproductive status noted, then released.

Where data are analyzed statistically, standard procedures and tests were followed as described by Sokal and Rohlf (1981). G-tests were used to examine the null hypothesis of equal proportions in frequency distributions, the null hypothesis of equal means in normally-distributed data sets was examined using t-tests No particular probability level was assumed as representing statistical significance, other than to consider a $P$-value of 0.05 or less to fall within that nebulous category. Some tests were run using STATISTIX version 2.0 (Analytical Software; Tallahassee, Florida).

## RESULTS

*General Summary of External Surveys*

External inspections of 173 workings at 88 abandoned mine sites were documented in 1997-1998 during this survey (Table 1). Of these workings, 77 were adits, 90 were "shafts" (see Methods), and 6 were pits. Ninety-two workings were monitored for bat activity at least one night: 78 with bat detectors and 39 (14 exclusively) with mist nets and/or a harp trap. Some workings were monitored more than once using more than one method (Table 1). Elevation of mine workings ranged from 4970' to 8700'. Monitored adits (46) and shafts/pits (46) were distributed similarly by elevation (Fig. 1; $G = 1.780$, df = 2, $P > 0.4$). Dominant vegetation (cover type) was recorded at 87 (94.6%) of the monitored mine workings, of which 76 (87.4%) were in sagebrush steppe. Remaining cover types at mine workings included grassland (1), Douglas-fir (5), mixed conifer (1), spruce/fir (3), and whitebark/limber pine (1).

Evidence of bat use was gathered at 66 workings of 49 mine sites, ranging in elevation from 4970' to 7640', while elevation range of unused mine workings was 5150' to 8700'. Of these, in-hand identification of bats was made at 20 workings of 16 mine sites (Table 2). Bat activity was recorded by bat detectors at 50 workings of 40 mine sites (Table 3); of these, 41 workings at 30 mine sites were at locations where bats were not visually identified. Bat use based only on the presence of guano (usually only one or a few pellets) was recorded at 5 workings of 4 mine sites. Bat activity was recorded at 48 (63.2%) of the workings in sagebrush habitat, 4 (80%) in Douglas-fir habitat, each single working in the grassland, mixed conifer, and whitebark/limber pine habitats, and none of the workings in spruce/fir habitat.

*Bat Species Captured or Observed*

During 1997-1998, 64 bats representing four species were captured or observed at 20 different workings of 16 mine sites (Table 2). Six individuals of two species may have been sampled twice < two weeks apart at the unnamed adit T4SR8WS18SENW, as the sexes and numbers of each species in each sample were identical. However, forearm measurements and scars did not closely match, so here I assume that 12 different individuals were captured. The Western Small-footed Myotis (*Myotis ciliolabrum*) represented 78.1% of the total (n = 44 m, 5 f, 1 ?), Western Long-eared Myotis (*M. evotis*) 14.1% (n = 7 m, 2 f), Townsend's Big-eared Bat (*Corynorhinus townsendii*) 4.7% (n = 2 m, 1 ?), and Big Brown Bat (*Eptesicus fuscus*) 3.1% (n = 1 m, 1 ?). These species were captured or observed at 17, 5, 3, and 2 workings, respectively. Maximum number of captures during nights when bats were captured (n = 17) was 9 bats, the mean was 3.12±2.29/night. Successful trapping occurred between 11 June and 21 August.

Sex ratio of the 61 bats assigned to sex was extremely male-biased (7.71 males for every female). Sex ratio for the two *Myotis* species combined was 7.29 males:1 female ($G = 37.683$, $P << 0.001$). Sex ratio of each species was *M. ciliolabrum* = 8.8 males:1 female ($G = 17.817$, $P << 0.001$), and *M. evotis* = 3.5 males:1 female.

Evidence of reproductive activity was scant. A lactating female *M. evotis* was captured on 6 August 1998 at the unnamed adit T4SR8WS18SENW, a second lactating female *M. evotis* was captured on 17 August 1998 at the same adit. Three female *M. ciliolabrum* with evident teats (non-nursing) were captured on 11 June 1998 at the unnamed adit T3SR7WS8SESE. Three captured males were classified as scrotal. one *E. fuscus* at the Kent/Bluewing E on 24 July 1998, one *M. ciliolabrum* at the Kent/Bluewing F also on 24 July 1998, and one *M. evotis* at the Huron/Cottontail C on 20 August 1997.

*Ultrasonic Monitoring*

Ultrasonic bat detectors were placed at 78 different workings (Table 1). Bat activity was detected on at least one night at 51 (65.4%) of the workings (Table 3). Most detections (at 47 of 50 workings) were classified as unknown bat or *Myotis* species; for 992 recorded passes during the survey, 793 (79.9%) were classified in these two groupings. Western Long-eared Myotis (*Myotis evotis*) was tentatively determined at 10 workings, Big Brown Bat (*Eptesicus fuscus*) at 12 workings, Townsend's Big-eared Bat (*Corynorhinus townsendii*) at 6 workings, and Silver-haired Bat (*Lasionycteris noctivagans*)/Hoary Bat (*Lasiurus cinereus*) at 4 workings, 3 of which were shafts. Shafts probably are the kind of mine working where these non-mine inhabiting species are most likely to be detected, as they forage over the mine area.

Activity at most sites was relatively low, based on the number of passes detected. For 54 nights of monitoring at 50 workings (number of passes were not recorded at one site), the mean number of passes (± SD) was 18.4±38.2. The large standard deviation indicated the wide range of activity at individual sites where bats were detected (from 1 to 187 passes/detector night). Only 16 (31.4%) of the samples included > 10 passes/detector night, and eight of these were < 30 passes. For workings with <30 passes/detector night (n = 47), the mean number of passes was 6.3±5.2. Sites with more than 100 passes/detector night included the Ermont #19 pit + shaft (145 passes on 18 August 1997), Hendricks gated adit (154 passes on 21 August 1997), and the unnamed shaft T3SR7WS33NESW (187 passes on 29 June 1998). Of course, there was no way of determining how many individual bats were active at any of the workings based only on the recorded vocalizations. Also, weather and battery failure interfered with some all-night recordings, limiting their reliability as a measure of relative activity.

*Patterns of Mine Use*

Bats used all three categories of mine workings (adits, "shafts", pits) across a wide range of elevations and habitat types, from 9 June to 15 October (nearly the extreme dates for external surveys). However, some patterns of mine use were evident upon closer examination of the data. The analyses that follow are necessarily crude, because several variables that were not sampled adequately may also influence patterns. These will be addressed at greater length in the Discussion.

Mine sites with evidence of bat use tended to be at lower elevations (Fig. 2; $G = 6.680$, df $= 2$, $P < 0.05$). Over 86% of monitored sites <6000' showed evidence of bat use, while the respective values for 6000-6999' and >7000' were 57.6% and 62.5%.

The proportion of mine sites with solitary workings that were used by bats (78.8% of 33 sites) was similar ($G = 0.256$, $P > 0.5$) to use of mine sites with more than one working (84% of 25 sites). Obviously, the criterion used to define a solitary or isolated working was very arbitrary (whether or not the named or apparent mine site had one or multiple significant and open workings). Using a larger number of categories to define the number of portals per mine site may result in a different conclusion. Such was not possible in this inventory because of relatively small samples of monitored mine sites with different numbers of workings.

A rough measure of portal size could be calculated for 50 of the monitored workings. Mean area (± SD) of used workings (2.80 ± 5.35 $m^2$, n = 33) was slightly smaller that for non-used workings (3.44 ± 4.18 $m^2$, n = 17), but the difference was not statistically significant ($t$ = 0.43, df = 48, $P = 0.670$). Some used workings were covered with wire netting or gates, and the "mesh size" was used in the above calculation. Using only the portal area itself behind the gate or mesh made the actual mean area of openings at used workings (3.26 ± 5.19 $m^2$) nearly identical with that of non-used workings. The large standard deviations indicate the wide range in portal sizes at used and unused workings.

Each major type of mine working was used by bats, but there was a difference in the frequency of their use (Fig. 3). Adits were used in much greater frequency than shafts (including pits) in 1998 ($G = 8.720$, df = 1, $P < 0.005$). This result is not biased by elevation distribution of the different types of sampled workings, as distributions were very similar (Fig. 1). Only 1998 data were used in this analysis, however, as there was slight overlap in the range of survey dates during the two years. External surveys were conducted from 4 August-16 October in 1997 and 9 June-19 August in 1998. Nevertheless, the pattern was similar, albeit weaker, in 1997, when 65.6% of monitored adits were used by bats versus 50% of shafts ($G = 1.242$, $P > 0.1$). Different dates of sampling (as well as different sampling conditions) may account for some of the annual disparity.

Obstructed openings also affected use of mine workings by bats. Bats were detected at 41.7% of unobstructed shafts (n = 24) and 65.2% of unobstructed adits (n = 23) that were monitored in 1998. Respective values for obstructed workings were 11.1% (n = 9) and 63.6% (n = 11). For years combined (including mine workings sampled in both years), 60% of unobstructed workings were used versus 42.9% for obstructed workings. Bats were more likely to use unobstructed adits in 1998 than unobstructed shafts ($G = 2.644$, $P = 0.12$). Likewise, bats were more likely to use obstructed adits in 1998 than obstructed shafts ($G = 6.222$, $P < 0.025$). Even though some workings were grated, screened or gated, all sampled workings were considered as possible bat habitat because each provided potential avenues of access to underground workings around the obstruction.

*Internal Surveys*

Twelve mine workings were inspected internally in 1998 for the presence of bats (Tables 1 and 4). Two of these were steep inclines ("shafts"), the remainder were simple or complex adits. Elevation of these mines ranged from 5640-7380'. Eight were < 200' in length, relatively simple, and completely explored. Mine air temperature in September in this group ranged from 47.5-52.0°F near the drift faces. Another two (Unnamed Gold Deposit #2 and #3) were > 200' but not fully explored (mine air temperature = 48.0°F), and the last two mines (Union #4 and Hendricks) were > 400' and >1000' in length, respectively, with multiple levels, but not fully explored. Air temperature 323' from the portal of the Union #4 was 55°F. Air temperature in the Hendricks ranged from 41.5°F (400' from the portal) to 54°F (700' from the portal). Most mines were damp or contained standing water, but at least two were completely dry at the time of inspection. Data loggers were placed in six of the mine workings in September and will be retrieved in late August 1999. Each data logger is set to record mine air temperature and relative humidity every 6 hours.

Only the Hendricks Mine had significant quantities of guano scattered throughout the mine workings. Scattered guano in small quantities was present in the other mines. Bats were observed during internal surveys of three mines. One Western Small-footed Myotis (*Myotis ciliolabrum*) was observed in the Hendricks Mine on 13 June. Also in the Hendricks, one Small-footed Myotis and one Big Brown Bat (*Eptesicus fuscus*) were observed hibernating about 320' from the portal on 4 December (D. Kampwerth, pers. comm.), near one of the temperature and humidity dataloggers. The large amount of guano throughout the passages of this mine suggest greater use by bats than revealed in this study. In other mines, one Townsend's Big-eared Bat (*Corynorhinus townsendii*) was observed in the Plainview B on 11 July, and one fresh dead Western Small-footed Myotis was found in the Unnamed Gold deposit #2 on 3 September.

## DISCUSSION

*General*

The most abundant bat species using the abandoned mines surveyed in the study area (Table 1) is probably the Western Small-footed Myotis (*Myotis ciliolabrum*); 49 (78.1%) of the 64 bats captured or identified by sight were this species (Table 2). This species was captured at 17 workings, over three-fold more than for any other species. The Western Long-eared Myotis (*M. evotis*) appears to be the second most abundant bat using the mines, comprising another 14.1% (n = 9) of the total captured. This species was captured at 5 mine workings and tentatively identified with bat detectors at another 10 (Tables 2 and 3). These two species combined probably also comprised the majority of unknown bat and *Myotis* species determined on the bat detector recordings (Table 3). Both species are widespread in arid-land and forested habitats of the western United States (van Zyll de Jong 1985, Nagorsen and Brigham 1993, Ports and Bradley 1996, Szewczak et al. 1998, Kuenzi et al. 1999).

Townsend's Big-eared Bat (*Corynorhinus townsendii*), a BLM Special Status species in Montana, was captured or sight-identified at 3 workings (Table 2), and tentatively determined at another 3-6 workings using ultrasound detectors (Table 3). These encounters occurred in seven townships, suggesting a broad geographical distribution at a low-level of abundance. This species also is routinely encountered using mines and caves in arid habitats (Humphrey and Kunz 1976, van Zyll de Jong 1985, Nagorsen and Brigham 1993, Ports and Bradley 1996, Szewczak et al. 1998, Kuenzi et al. 1999). The Big Brown Bat (*Eptesicus fuscus*) was the fourth species captured (at 1 working and observed in another), and was tentatively identified with ultrasound detectors at 10 additional workings. This species is widespread over much of North America (van Zyll de Jong 1985, Nagorsen and Brigham 1993). The final two species, Silver-haired Bat (*Lasionycteris noctivagans*) and Hoary Bat (*Lasiurus cinereus*), were tentatively identified only with bat detectors at 4 mine workings. Both species rarely use mines and caves for roosts (van Zyll de Jong 1985, Nagorsen and Brigham 1993), so their presence at mine workings is likely a reflection of their foraging activity near these sites.

Bat activity in the inventory area was widespread during 1997-1998. However, intensity of activity was relatively low at most sites, suggesting that the majority of used abandoned mine workings served as night and/or day roosts. This does not mean that the mines are not important for the bat populations of the survey area. Low population densities of bats could easily account for the relatively low activity at many workings, and sites in which to rest between foraging forays remain important habitat components for bats.

None of the mine workings appeared to serve as a maternity roost, although this conclusion is based on circumstantial evidence. Few female bats were captured (Table 2), and mine air temperatures were likely too cool for maternity sites (see discussion in Betts 1997). Instead, most females raising developing young probably were using natural cavities in trees and rock outcrops, where warmer temperatures occur (e.g., Humphrey and Kunz 1976, Dobkin et al.

1995, Bogan et al. 1996, Vonhof and Barclay 1996, Kalcounis and Brigham 1998, Ormsbee and McComb 1998, Rabe et al. 1998).

The degree to which any of the examined workings are used by bats as hibernacula is largely unknown. It can be very difficult to determine the importance of a mine as a hibernaculum based solely on external surveys unless a visit happens to coincide with bats returning to the site to overwinter. Internal temperature regimes, mean annual surface temperatures, and mine complexity may be good predictors of such use in some areas (e.g., Dwyer 1971, Tuttle and Taylor 1994), and such information could help in judging the necessity for future internal surveys at selected sites. Some aspects of internal temperature and relative humidity regimes of mines in southwestern Montana may be inferred from data obtained through the data loggers in place from September 1998 to August 1999. These records will be supplied in a supplemental report following instrument retrieval and data analysis.

The Hendricks is currently the only mine in the study area that is known to be a hibernaculum; one *M. ciliolabrum* and one *E. fuscus* were found hibernating in the mine on 4 December 1998 (Tables 2 and 4, D. Kampwerth pers. comm.). This mine is on land formerly owned by the BLM but now under jurisdiction of Bannock State Park. It seems probable, however, that several other mine hibernacula are present on BLM lands in the inventory area. The four bat species captured during this study have been documented over-wintering in mines or caves elsewhere in Montana (Swenson 1970, Swenson and Shanks 1979, Hendricks et al. 2000), Idaho (Genter 1986), and Wyoming (Priday and Luce 1997). Two studies where *M. ciliolabrum* and *C. townsendii* co-occur (Genter 1986, Kuenzi et al. 1999) indicate that the former species may occupy slightly colder hibernacula.

*Mine Selection*

Results of this inventory showed that bat activity at monitored abandoned mines was not uniform across the study area. On a landscape scale, higher-elevation workings (> 6000') were used less frequently than workings at lower elevations (Fig. 2). Why this should be so is not entirely clear, especially given that most used workings appeared to be night roosts. In regional and local studies, reproductive females favor lower elevations, presumably because of the more favorable climate conditions in which to raise young (Thomas 1988, Nagorsen and Brigham 1993, Storz and Williams 1996). Their absence from higher-elevation areas still would not explain why mine workings were visited less frequently by males and non-reproductive females. Perhaps population densities of bats at higher elevations in this region are extremely low for reasons other than the availability of underground roosts.

On a more local scale, unobstructed workings were more likely to be used, although the difference for adits was very slight. More surprisingly, adits, whether obstructed or not, were more likely to be used than shafts (Fig. 3). Why partially obstructed workings might deter bat use is seemingly self-evident, through inhibiting access. The differential use of adits and shafts is less easily explained. I am not aware of other studies showing a preference for one kind of working over another, either within a suite of bat species, or by any particular species of bat. It is possible that horizontal adits may better hold warm air overnight than vertical shafts, and that bats seek warmer places to night roost. In Arizona it has been shown that night roosting by Pallid Bats (*Antrozoas pallidus*) in horizontally oriented grottos typically began when external air temperature cooled below that of the warmer internal air (O'Shea and Vaughan 1977). It is also possible that some species of bats prefer to enter horizontal workings. This pattern merits additional study.

There are factors that confound the differential use of adits and shafts, however, making tentative the conclusions drawn from that pattern. First, obstructions at shafts, especially grates, may be more effective barriers to bats, even though there may be a missing door in the grate, or there is some sloughing below the edges that might allow access near ground-level. Obstructions at adits often include gates, cable netting, partially open wooden doors or collapsed headframes, etc. with spaces allowing the passage of bats. Therefore, not all partial obstructions are equal, and those usually associated with shafts appear to be more effective in excluding bats. Second, shafts may be more likely to be obstructed by debris falling from the ground surface and accumulating in passages beyond the portal, as a result of their morphology. Because most workings (many adits as well as all shafts except two inclines) were not explored internally, there is no way of knowing what conditions they offered to bats. This is probably the most important shortcoming in attempting to develop external criteria for predicting mine suitability to bats; surface conditions may be completely unrelated to conditions underground

Access to water is an important component in the spatial environment of bats that affects where they are active. This could not be realistically measured during this inventory, as there are many unmapped sources of surface water in most areas and at many times during an active season. However, most monitored workings were within 2 km of known surface streams or stock ponds, well within the nightly foraging distance from roosts of some bat species (e.g., Wai-Ping and Fenton 1989, Dobkin et al. 1995). Furthermore, water is sometimes available underground. At least 4 (25%) of the workings explored underground in 1998 had significant pools of standing water within them. Without access to all workings (including those on private land), proximity to water at any mine is speculative but is unlikely to be a significant factor influencing mine use in this study area.

Some potential confounding variables that could influence the detected patterns can be eliminated. The majority (87%) of workings was in sagebrush habitat, so vegetation cover type probably had a minor influence at most on which mine workings were used. Also, the samples of monitored adits and shafts were distributed similarly by elevation (Fig. 1), so their relative distributions across an elevation gradient had little influence on the preference shown for lower-elevation mines, if indeed adits really are favored by bats in this region (see Fig. 3).

Neither portal size nor the number of potentially suitable portals at a mine site affected the pattern of mine use by bats. Results of the portal size analysis could be biased for reasons previously addressed (not all partial obstructions can be equally by-passed by bats), but the distribution of grated shafts was roughly equal in the used and unused groups. However, number of portals at a mine site was classified into only two categories, one and more than one. With a larger sample containing multiple portals per mine, a different pattern may appear. Also, distance between portals needs to be measured metrically, rather than classified by mine name. To do this analysis properly, it is necessary to include mine workings on private lands, unless study areas are kept smaller than that of this inventory, and where access to all mines can be assured.

## MANAGEMENT CONSIDERATIONS

### *Mine use by bats and mine climate*

It is desirable to gather long-term climate data, using electronic data loggers, from a variety of mines used by bats as maternity, hibernation, and/or night roosts in Montana. These baseline data will enhance the accuracy of future determinations of abandoned mine suitability for bats in Montana, especially for sites where no bats were directly observed.

Identifying mines used by bats can be relatively simple. For mines where entry is possible, presence of bat droppings indicates a mine has been used relatively recently. For mines considered too hazardous to enter, or where entry is prohibited or limited due to obstructions, use of electronic bat detectors or some form of capture technique can provide evidence of current use. Yet determining *why* bats are using different mines may be more involved. Reason for use (of interest to bat biologists and animal ecologists) may be immaterial to a management agency, so long as used sites are identified and protected. However, limited monetary resources could restrict the number of used mines that can be protected and maintained for bats. In such cases, highest priority mines are those used as maternity and/or hibernation roosts (Tuttle and Taylor 1994), and it is very desirable to identify these from night roosts, places where bats rest in safety to digest an evening meal.

In the Beaverhead/Madison counties survey area, most mines where bats were recorded appeared to be summer night/day roosts, with only a subset of these known or likely to be hibernacula. Temperatures recorded during internal inspections in June and September (8.5-16.5°C) were near or below lower threshholds recorded at maternity colonies in other areas (e.g., Twente 1955, Tuttle and Stevenson 1978, Pierson et al. 1991, Betts 1997, Williams and Brittingham 1997, Hurst and Lacki 1999). However, our temperature and relative humidity data are of limited use because they were taken usually during a single visit, and do not provide an adequate picture of temporal or spatial climate variation within many of these mines.

The microclimate of a mine, especially temperature and relative humidity, determines whether bats can use it at all and if so, in which season and for what purpose. In Montana, long-term climate data are not available for mines used by bats. Currently, climate measurements taken during internal mine surveys to determine potential suitability for bats throughout their annual cycle are compared with roost data from other regions. However, there is no reason to assume a priori that ranges in climate variables at roosts are invariant across species ranges, and we anticipate that climate in mines used for roosts in Montana may be somewhat cooler than in more southern regions of western North America. Using climate data from elsewhere as the basis for determining the range of suitable sites in Montana might result in exclusion of some usable mines.

Once more is learned from the data logger samples of climate regimes in the abandoned mine workings where they were placed (each of which was used by bats), it may be suitable for the BLM to a) consider sponsoring additional internal hibernacula surveys according to temperature, b) put an emphasis on future searches for maternity colonies in unsurveyed mines at lower elevations, and/or c) assign priorities for protection in a way that also considers likely thermal regimes best suited for bat hibernacula or maternity use.

*Importance of abandoned mines in the inventory area*

The determination of importance or significance of a mine working for bats is difficult. Almost any mine working in the inventory area still accessible to bats should be considered potentially important for them, especially those at which monitoring was conducted (Table 1), and particularly for workings where significant activity was recorded (e.g., bats captured, more than 10 passes recorded; see Tables 2 and 3). These comments are based on a combination of factors, including inadequate surveying of the entire area (partly due to complex ownership patterns), incomplete monitoring at mines visited (e.g., multi-season visits [see Altenbach 1995] were largely impractical for logistical and monetary reasons), and localized availability of surface water with inadequate knowledge of how bats use the landscape around roosts. Also, the importance for bats of mines on private lands in the study area is unknown, and long-term security of these for use as bat roosts is also open to question.

Mines with obstructions are, on average, less attractive to bats for roosts, but some of these were used nevertheless. Removal of obstructions should be considered as an option for making mine workings more attractive to bats, especially at some mines where grated shafts predominate (the Emma is an example). Mine workings where bat activity was confirmed should be gated or protected by means other than closure. This assumes that policy dictates they are to be made accessible to bats but not to humans and/or livestock, and that adequate funding exists or can be allocated for such management activity. With limited funding, highest priority for protection should be given to those workings with the greatest amount of documented activity, and sites where Townsend's Big-eared Bat (a BLM Special Status species in Montana) was identified.

*Mine closure methods*

Bat friendly gates (see Tuttle and Taylor 1994, Dalton and Dalton 1995) should be installed on adit portals not already protected. Gates should be constructed such that they do not restrict air movement or passage of bats, yet prohibit livestock and unauthorized human entry. A bat-friendly gate design has been installed by the Mine Waste Cleanup Bureau, Montana Department of Environmental Quality at four abandoned mine adits elsewhere in Montana that are known to be used as hibernacula and/or maternity roosts by Townsend's Big-eared Bat (*Corynorhinus townsendii*). These adits were still in use in 1999 by this species and at least one species of *Myotis* three years after gate installation. The design uses 13 mm rebar with recommended spacing (5.75 inch vertical, 24 inch horizontal) on a swinging gate, secured by a protected lock (not an exposed chain and/or lock) and secured to the end of a corrugated metal pipe that is inserted into the mine portal. The corrugated pipe is then covered with fill to assure that entry is through the pipe and gate. Cable netting (usually about 8 x 8 inches mesh size) has been used with success in a few situations, but is more easily breached by humans than are properly designed gates. Cable netting is suitable primarily to maintain mine airflow while hindering access by humans and livestock, and is not recommended for protecting portals used by bats.

The current gate design used on many shafts in the study area, where a fine-mesh grate (mesh size of 1 x 3 inches) is placed at ground level over the portal, effectively prevents their use by bats. Many grated shafts have the potential to be used by bats if they were made more bat-friendly. Current grates can be replaced with grates built with angle iron having the proper spacing (5.75 x 24 inches) that will allow passage of bats (Dalton and Dalton 1995). However, use of this design without fencing may fail to prevent livestock from stumbling onto these and being injured. Replacement of the current grate design with a box-type or "cupola" design (e.g., Tuttle and Taylor 1994) on shafts currently protected should be considered. Fencing around shafts, the least obtrusive method to bats for preventing injury to livestock, fails to address the potential hazard for humans.

## LITERATURE CITED

Altenbach, J. S. 1995. Entering mines to survey bats effectively and safely. Pp. 57-61 *in* Riddle, B. R. (ed.). Inactive mines as bat habitat: guidelines for research, survey, monitoring and mine management in Nevada. Biological Resources Research Center, University of Nevado, Reno.

Barclay, R. M. R. 1999. Bats are not birds—a cautionary note on using echolocation calls to identify bats: a comment. Journal of Mammalogy 80:290-296.

Betts, B. J. 1997. Microclimate in Hell's Canyon mines used by maternity colonies of *Myotis yumanensis*. Journal of Mammalogy 78:1240-1250.

Betts, B. J. 1998. Effects of interindividual variation in echolocation calls on identification of Big Brown and Silver-haired bats. Journal of Wildlife Management 62:1003-1010.

Bogan, M. A., J. G. Osborne, and J. A. Clarke. 1996. Observations on bats at Badlands National Park, South Dakota. Prairie Naturalist 28:115-123.

Dalton, D. C., and V. M. Dalton. 1995. Mine closure methods including a recommended gate design. Pp. 130-135 *in* Riddle, B. R. (ed.). Inactive mines as bat habitat: guidelines for research, survey, monitoring and mine management in Nevada. Biological Resources Research Center, University of Nevado, Reno.

Dobkin, D. S., R. D. Gettinger, and M. G. Gerdes. 1995. Springtime movements, roost use, and foraging activity of Townsend's Big-eared Bat (*Plecotus townsendii*) in central Oregon. Great Basin Naturalist 55:315-321.

Dwyer, P. D. 1971. Temperature regulation and cave-dwelling in bats: an evolutionary perspective. Mammalia 35:424-455.

Fenton, M. B., H. G. Merriam, and G. L. Holroyd. 1983. Bats of Kootenay, Glacier, and Mount Revelstoke national parks in Canada: identification by echolocation calls, distribution, and biology. Canadian Journal of Zoology 61:2503-2508.

Gates, J. E., G. A. Feldhamer, L. A. Griffith, and R. L. Raesley. 1984. Status of cave-dwelling bats in Maryland: importance of marginal habitats. Wildlife Society Bulletin 12:162-169.

Genter, D. L. 1986. Wintering bats of the Upper Snake River Plain: occurrence in lava-tube caves. Great Basin Naturalist 46:241-244.

Hendricks, P. 1997. Mine assessments for bat activity, Garnet Resource Area, BLM: 1997. Montana Natural Heritage Program. Helena, MT. 17 pp.

Hendricks, P., D. L. Genter, and S. Martinez. 2000. Bats of Azure Cave and the Little Rocky Mountains, Montana. Canadian Field-Naturalist 114: in press.

Humphrey, S. R. 1978. Status, winter habitat, and management of the endangered Indiana Bat, *Myotis sodalis*. Florida Science 41:65-76.

Humphrey, S. R., and T. H. Kunz. 1976. Ecology of a Pleistocene relict, the Western Big-eared Bat (*Plecotus townsendii*), in the southern Great Plains. Journal of Mammalogy 57:470-494.

Hurst, T. E., and M. J. Lacki. 1999. Roost selection, population size and habitat use by a colony of Rafinesque's Big-eared Bats (Corynorhinus rafinesquii). American Midland Naturalist 142:363-371.

Hutto, R. L., and J. S. Young. 1999. Habitat relationships of landbirds in the Northern Region, USDA Forest Service. General Technical Report RMRS-GTR-32. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 72 pp.

Kalcounis, M. C., and R. M. Brigham. 1998. Secondary use of aspen cavities by tree-roosting Big Brown Bats. Journal of Wildlife Management 62:603-611.

Kuenzi, A. J., G. T. Downard, and M. L. Morrison. 1999. Bat distribution and hibernacula use in west central Nevada. Great Basin Naturalist 59:213-220.

LaVal, R. K., and M. L. LaVal. 1980. Ecological studies and management of Missouri bats, with emphasis on cave-dwelling species. Missouri Department of Conservation, Terrestrial Series #8. 53 pp.

Nagorsen, D. W., and R. M. Brigham. 1993. The bats of British Columbia. University of British Columbia Press, Vancouver, British Columbia. 164 pp.

Nesser, J. A., G. L. Ford, C. L. Maynard, and D. S. Page-Dumroese. 1997. Ecological units of the Northern Region: subsections. General Technical Report INT-GTR-369. Ogden, UT: USDA Forest Service, Intermountain Research Station. 88 pp.

O'Farrell, M. J. 1997. Use of echolocation calls for the identification of free-flying bats. Transactions of the Western Section of The Wildlife Society 33:1-8.

O'Farrell, M. J. 1999. Blind test for ability to discriminate vocal signatures of the Little Brown Bat *Myotis lucifugus* and the Indiana Bat *Myotis sodalis*. Bat Research News 40:44-48.

O'Farrell, M. J., B. W. Miller, and W. L. Gannon. 1999. Qualitative identification of free-flying bats using the Anabat detector. Journal of Mammalogy 80:11-23.

Ormsbee, P. C., and W. C. McComb. 1998. Selection of day roosts by female Long-legged Myotis in the central Oregon Cascade Range. Journal of Wildlife Management 62:596-603.

O'Shea, T. J., and T. A. Vaughan. 1977. Nocturnal and seasonal activities of the pallid bat, *Antrozoas pallidus*. Journal of Mammalogy 58:269-284.

Pierson, E. D., W. E. Rainey, and D. M. Koontz. 1991. Bats and mines: experimental mitigation for Townsend's Big-eared Bat at the McLaughlin Mine in California. Pp. 31-42 *in* Proceedings V: Issues and technology in the management of impacted wildlife. Thorne Ecological Institute, Boulder, CO.

Ports, M. A., and P. V. Bradley. 1996. Habitat affinities of bats from northeastern Nevada. Great Basin Naturalist 56:48-53.

Priday, J., and B. Luce. 1997. Inventory of bats and bat habitat associated with caves and mines in Wyoming: completion report. Pp. 50-109, *In* Endangered and nongame bird and mammal investigations annual completion report. Unpublished report, Nongame Program, Wyoming Game and Fish Department. 234 pp.

Rabe, M. J., T. E. Morrell, H. Green, J. C. deVos, Jr., and C. R. Miller. 1998. Characteristics of ponderosa pine snag roosts used by reproductive bats in northeastern Arizona. Journal of Wildlife Management 62:612-621.

Richter, A. R., S. R. Humphrey, J. B. Cope, and V. Brack, Jr. 1993. Modified cave entrances: thermal effect on body mass and resulting decline of endangered Indiana Bats (*Myotis sodalis*). Conservation Biology 7:407-415.

Sheffield, S. R., J. H. Shaw, G. A. Heidt, and L. R. McClenaghan. 1992. Guidelines for the protection of bat roosts. Journal of Mammalogy 73:707-710.

Sokal, R. R., and F. J. Rohlf. 1981. Biometry, second edition. W. H. Freeman, San Francisco. 859 pp.

Storz, J. F., and C. F. Williams. 1996. Summer population structure of subalpine bats in Colorado. Southwestern Naturalist 41:322-324.

Swenson, J. E. 1970. Notes on distribution of *Myotis leibii* in eastern Montana. Blue Jay 28:173-174.

Swenson, J. E., and G. F. Shanks, Jr. 1979. Noteworthy records of bats from northeastern Montana. Journal of Mammalogy 60:650-652.

Szewczak, J. M., S. M. Szewczak, M. L. Morrison, and L. S Hall. 1998. Bats of the White and Inyo Mountains of California-Nevada. Great Basin Naturalist 58:66-75.

Thomas, D. W. 1988. The distribution of bats in different ages of Douglas-fir forests. Journal of Wildlife Management 52:619-626.

Tuttle, M. D. 1979. Status, causes of decline, and management of endangered Gray Bats. Journal of Wildlife Management 43:1-17.

Tuttle, M. D., and D. E. Stevenson. 1978. Variation in the cave environment and its biological implications. Pp. 108-121 *in* 1977 National Cave Management Symposium Proceedings (R. Zuber, J. Chester, S. Gilbert, and D. Roberts, eds.). Adobe Press, Albuquerque, NM. 140 pp.

Tuttle, M. D., and D. A. R. Taylor. 1994. Bats and mines. Bat Conservation International Resource Publication Number 3. 41 pp.

Twente, J. W., Jr. 1955. Some aspects of habitat selection and other behavior of cavern-dwelling bats. Ecology 36:706-732.

van Zyll de Jong, C. G. 1985. Handbook of Canadian mammals. 2. Bats. National Museum of Natural Sciences. Ottawa, Ontario. 212 pp.

Vonhof, M. J., and R. M. R. Barclay. 1996. Roost-site selection and roosting ecology of forest-dwelling bats in southern British Columbia. Canadian Journal of Zoology 74:1797-1805.

Wai-Ping, V., and M. B. Fenton. 1989. Ecology of Spotted Bat (*Euderma maculatum*) roosting and foraging behavior. Journal of Mammalogy 70:617-622.

Williams, L. M., and M. C. Brittingham. 1997. Selection of maternity roosts by Big Brown Bats. Journal of Wildlife Management 61:359-368.

Table 1  Mine sites surveyed for potential/actual use by bats in southwestern Montana during 1997-1998  Sites with evidence of bat activity are indicated with a "+", mine workings inspected internally are marked with a "*".

| Mine Site | Type | Date | Elev (ft) | Lat. (N) | Long. (W) | Legal TRS | Survey Method |
|---|---|---|---|---|---|---|---|
| +*Ruth & Copper Bottom | adits (3) | 9 Jul 98+<br>2 Sep 98* | 7400 | 45° 43' 11" | 112° 36' 15" | T1SR8WS28NWSW | visual (1 dropping)<br>longest adit |
| Unnamed (collapsed) | shaft | 20 Aug 98 | 5900 | | | T1SR10WS9NWNW | visual |
| Strawberry A | adit | 16 Sep 97 | 6440 | | | T2SR3WS14SENW | Anabat |
| Strawberry B | adit | 14 Aug 98 | 6800 | | | | Anabat |
| Strawberry C | adit | | 6800 | 45° 39' 53" | 111° 56' 21" | | Anabat |
| +Strawberry D | shaft | 17 Sep 97+ | 7200 | | | | Anabat |
| +Strawberry E | shaft | 14 Aug 98 | 7280 | 45° 39' 53" | 111° 56' 21" | | Anabat |
| Mountain Cliff A (gated) | adit | 17 Sep 97 | 8160 | | | T2SR3WS15NENW | Anabat |
| Mountain Cliff B (gated) | adit | | 8700 | | | | Anabat |
| Mountain Cliff C | shaft | | 8700 | | | | Anabat |
| +Mohawk A | adit | 25 Sep 97+<br>19 Aug 98 | 5960 | | | T2SR6WS10SENW | Anabat<br>Anabat |
| +Mohawk B | shaft | 25 Sep 97+ | | | | | Anabat |
| Mohawk C (collapsed) | adit | | | | | | visual |
| +Unnamed adit (gated) | adit | 25 Sep 97<br>19 Aug 98+ | 6200 | | | T2SR6WS10SWNW | Anabat<br>Mist net |
| +Gold Rod (mesh netting) | adits (2) | 10 Jul 98 | 5100 | 45° 39' 16" | 112° 19' 19" | T2SR6WS22NENE | Anabat, Harp trap |
| Short Shrift (partly covered) | shaft | 9 Jul 98 | 6940 | 45° 41' 09" | 112° 30' 31" | T2SR7WS6SESE | Mist net |
| +Watseca | shaft | 6 Aug 97 | 5880 | 45° 37' 10" | 112° 30' 22" | T2SR7WS31SENE | Anabat |
| +Beacon Light | adit | 30 Jun 98 | 5860 | | | T2SR7WS31SWSE | Mist net |
| +Champion | shaft | 6 Aug 97 | 5800 | 45° 36' 55" | 112° 30' 30" | T2SR7WS31NESE | Anabat |
| +Dick & Billy Jane (grated) | shafts (2) | 6 Aug 97 | 5840 | 45° 36' 59" | 112° 31' 03" | T2SR7WS31NESW | Anabat |
| Gold Nugget #1 (covered) | shaft | 27 Jun 98 | 5900 | 45° 37' 26" | 112° 29' 16" | T2SR7WS32NENE | Anabat |
| Gold Nugget #2 | shaft | | 6000 | 45° 37' 18" | 112° 29' 06" | | Anabat, Mist net |
| Gold Nugget #3 | shaft | | 5900 | 45° 37' 26" | 112° 29' 31" | | Anabat |
| Horn Silver (collapsed) | shaft | 7 Jul 98 | 6700 | 45° 41' 09" | 112° 37' 04" | T2SR8WS5SWSE | visual |
| Greylock | shaft | 7 Jul 98 | 6400 | 45° 41' 15" | 112° 37' 54" | T2SR8WS6SESE | Mist net |
| Greylock West (collapsed) | adit | 7 Jul 98 | 6400 | 45° 41' 21" | 112° 38' 06" | T2SR8WS6NWSE | visual |
| +Camp Creek | adit | 1 Jul 98 | 6050 | 45° 40' 55" | 112° 33' 39" | T2SR8WS11NENW | Anabat, Harp trap |
| Chlorite Gulch (collapsed) | adit, shaft | 17 Aug 98 | 6190 | 45° 39' 55" | 112° 36' 54" | T2SR8WS17SENE | Anabat |
| +Jackrabbit | shaft,adit+ | 6 Jul 98 | 6700 | 45° 38' 30" | 112° 35' 52" | T2SR8WS21NESW | Harp trap, Mist net |
| Unnamed (open door) | adit | 6 Jul 98 | 6760 | | | T2SR8WS21NWSE | Anabat |
| Unnamed PIG#3 (partly filled) | shaft | 7 Jul 98 | 6650 | 45° 37' 19" | 112° 35' 17" | T2SR8WS27NWNW | visual |

Table 1 (cont.). Mine sites surveyed for potential/actual use by bats in southwestern Montana during 1997-1998. Sites with evidence of bat activity are indicated with a "+", mine workings inspected internally are marked with a "*".

| Mine Site | Type | Date | Elev (ft) | Lat. (N) | Long. (W) | Legal TRS | Survey Method |
|---|---|---|---|---|---|---|---|
| Union Prospect | adit | 7 Jul 98 | 6600 | | | T2SR8WS28NENE | visual |
| Unnamed Prospects | adit | 7 Jul 98 | 6000 | 45° 37' 59" | 112° 36' 43" | T2SR8WS29NWNW | visual |
| +Maiden Rock | adit | 5 Aug 97 | 5400 | 45° 41' 46" | 112° 44' 13" | T2SR9WS5NENE | Anabat |
| +Unnamed (N of Helene) (2 collapsed) | shafts (4) | 8 Aug 98 | 5050 | | | T3SR1ES19NENW | Anabat, Mist net |
| +Helene (collapsed) | adits (2) | 8 Aug 98 | 4970 | | | T3SR1ES19NENW | Anabat, visual |
| Florence (collapsed) | adits (3) | 8 Aug 98 | 5250 | | | T3SR1ES19NWSE | visual |
| +Plainview A (grated culvert) | adit | 23 Sep 97 | 5680 | | | T3SR5WS28NWNW | Anabat |
| | | 11 Jul 98+ | | | | | Anabat |
| +*Plainview B | adit | 11 Jul 98 | | | | | visual |
| +Tidal Wave A | adit | 23 Sep 97+ | 5960 | 45° 32' 59" | 112° 13' 43" | T3SR5WS28NENW | Anabat |
| +Tidal Wave B (grated) | shaft | 10 Jul 98+ | 6000 | 45° 32' 59" | 112° 13' 30" | | Anabat, Mist net |
| Tidal Wave C (collapsed) | adit | | 5900 | | | | visual |
| Tidal Wave D (grated culvert) | adit | | 5900 | | | | visual |
| Pearson Prospect (adit collapsed) | shaft, | 24 Sep 97 | 6080 | | | T3SR5WS34SENW | Anabat |
| | adit | 22 Jul 98 | | | | | Mist net |
| +Falcon Prospect (partially collapsed) | shaft | 24 Sep 97+ | 5960 | 45° 31' 49" | 112° 12' 34" | T3SR5WS34NESW | Anabat |
| | | 10 Jul 98+ | | | | | Anabat |
| Walker adits (grated or collapsed) | adits (3) | 24 Sep 97+ | 5920 | 45° 31' 51" | 112° 12' 44" | T3SR5WS34NWSW | visual |
| +Walker shaft (collapsed 1998) | shaft | 10 Jun 98 | | | | | Anabat, visual |
| +Black Ace #1 (partially collapsed) | adit | 24 Sep 97+ | 6400 | | | T3SR5WS34NWNE | Anabat |
| | | 22 Jul 98+ | | | | | Anabat |
| +Black Ace #2 | adit | 22 Jul 98 | | | | | Anabat |
| Black Ace shaft | shaft | 24 Sep 97 | | | | | visual |
| Germania 1 | shaft | 28 Jun 98 | 5980 | 45° 36' 08" | 112° 27' 40" | T3SR7WS3NWSW | visual |
| +Germania 2 | adits (2) | | | 45° 36' 09" | 112° 27' 44" | | Anabat |
| Germania 3 | adit | | | 45° 36' 10" | 112° 27' 45" | | Mist net |
| +Germania 4 | shaft | | | 45° 36' 14" | 112° 28' 04" | | Anabat |
| April Claims | shaft/pit | 29 Jun 98 | 5800 | 45° 35' 59" | 112° 28' 12" | T3SR7WS4SWSE | visual |
| Gold King | shaft | 16 Oct 97 | 5900 | 45° 36' 04" | 112° 30' 03" | T3SR7WS5NWSW | Anabat |
| Emma A (grated) | shaft | 15 Oct 97+ | 6050 | 45° 35' 53" | 112° 31' 01" | T3SR7WS6SESW | Anabat, Mist net |
| Emma B (grated) | shaft | 10 Jun 98 | | 45° 35' 54" | 112° 30' 59" | | Anabat, Mist net |
| +Emma C | shaft | | | 45° 35' 56" | 112° 30' 57" | | Anabat, Mist net |
| Emma D (grated) | shaft | | | 45° 35' 56" | 112° 30' 56" | | visual |
| Emma E (grated) | shaft | | | 45° 35' 58" | 112° 30' 55" | | visual |

Table 1 (cont.) Mine sites surveyed for potential/actual use by bats in southwestern Montana during 1997-1998. Sites with evidence of bat activity are indicated with a "+", mine workings inspected internally are marked with a "*".

| Mine Site | Type | Date | Elev (ft) | Lat. (N) | Long. (W) | Legal TRS | Survey Method |
|---|---|---|---|---|---|---|---|
| +*Unnamed | adit | 9 Jun 98+<br>11 Jun 98+*<br>2 Sep 98* | 5860 | 45° 35' 08" | 112° 29' 21" | T3SR7WS8SESE | Anabat<br>Harp trap, Mist net<br>visual |
| +*Gold Seal | shaft | 11 Jun 98+<br>2 Sep 98* | 5880 | 45° 35' 26" | 112° 29' 43" | T3SR7WS8SWNE | Anabat<br>visual |
| +*Eclipse (at house) | shaft | 11 Jun 98+<br>2 Sep 98* | 5880 | 45° 35' 35" | 112° 29' 42" | T3SR7WS8SWNE | Anabat<br>visual |
| +Unnamed (above Eclipse) | adit<br><br>shaft | 10 Jun 98+<br>18 Aug 98 | 6040 | 45° 35' 38" | 112° 30' 01" | T3SR7WS8SENW | visual (guano)<br>Anabat<br>visual |
| +Shoemaker A<br>Shoemaker B (grated)<br>Shoemaker D<br>Shoemaker E<br>Shoemaker F<br>Shoemaker G<br>+Shoemaker H | shaft<br>shaft<br>shaft<br>adit<br>adit<br>shaft<br>shaft | 1 Oct 97+<br>9 Jun 98 | 5900 | | | T3SR7WS8SWNW | Anabat<br>Anabat, Mist net<br>Anabat<br>visual<br>visual<br>Anabat, Mist net<br>Anabat, Mist net |
| +Unnamed adits | adits (2) | 11 Jun 98 | 5600 | 45° 35' 40" | 112° 29' 20" | T3SR7WS9NWNW | visual (guano) |
| Unnamed adit | adit | 11 Jun 98 | 5480 | 45° 35' 30" | 112° 29' 59" | T3SR7WS9SWNW | visual |
| +Unnamed shaft | shaft | 11 Jun 98+<br>29 Jun 98 | 5740 | 45° 34' 53" | 112° 30' 28" | T3SR7WS18NENE | Anabat<br>Mist net |
| Nez Perce North (partially collapsed) | shaft | 30 Jun 98 | 5640 | 45° 33' 57" | 112° 29' 10" | T3SR7WS20NENE | visual |
| Unnamed (collapsed) | shafts (2) | 29 Jun 98 | 5500 | 45° 33' 26" | 112° 29' 09" | T3SR7WS20NESE | visual |
| "Water Tank" (collapsed) | shaft | 29 Jun 98 | 5150 | 45° 32' 35" | 112° 27' 32" | T3SR7WS27NWSW | visual |
| +Unnamed | shaft | 29 Jun 98 | 5350 | 45° 31' 46" | 112° 28' 41" | T3SR7WS33NESW | Anabat, Mist net |
| +Ajax (partially collapsed) | shafts (4) | 30 Jun 98 | 6040 | 45° 36' 37" | 112° 32' 35" | T3SR8WS1NWNW | Anabat (#3) |
| Montana Boy | shafts (3) | 8 Aug 98 | 5370 | | | T4SR1WS2SWNE | visual |
| Unnamed Gold Deposit #1 (collapsed)<br>+*Unnamed Gold Deposit #2<br>+*Unnamed Gold Deposit #3 | adit<br><br>adit<br>adit | 23 Jul 98+<br>3 Sep 98+* | 5800 | | | T4SR4WS32SENE | visual<br><br>Anabat, visual<br>Harp trap |
| Unnamed (collapsed) | adit | 23 Jul 98 | | | | T4SR4WS33NWSW | visual |

Table 1 (cont.). Mine sites surveyed for potential/actual use by bats in southwestern Montana during 1997-1998. Sites with evidence of bat activity are indicated with a "+", mine workings inspected internally are marked with a "*".

| Mine Site | Type | Date | Elev (ft) | Lat. (N) | Long. (W) | Legal TRS | Survey Method |
|---|---|---|---|---|---|---|---|
| Union #1<br>Union #2 (grated culvert)<br>Union #3 (grated)<br>+*Union #4 (gated, in brick)<br>+*Union #5 (grated culvert) | shaft<br>adit<br>shaft<br>adit<br>adit | 11 Jul 98+<br>1 Sep 98* | 5960<br>5960<br>5940<br>5920<br>5920 | <br><br>45° 31' 06"<br>45° 31' 06" | <br><br>112° 11' 55"<br>112° 11' 55" | T4SR5WS3SENE | Anabat<br>Anabat<br>visual<br>Harp trap, visual<br>Mist net, (guano) |
| +Unnamed (doors) | adits (2) | 6 Aug 98 | 6040 | | | T4SR8WS7NWNW | Anabat |
| +*Unnamed | adit | 7 Aug 98+<br>3 Sep 98* | 5800 | | | T4SR8WS7SWNW | Anabat, Mist net<br>visual |
| +*Unnamed | adit | 6 Aug 98+<br>17 Aug 98+<br>3 Sep 98* | 5640 | | | T4SR8WS18SENW | Harp trap<br>Harp trap<br>visual |
| Granite Creek Prospects | pits (2) | 7 Aug 98 | 6100 | | | T6SR3WS10NWNW | visual |
| Unnamed (collapsed inside) | adit | 7 Aug 98 | 6000 | | | T6SR3WS28SWSW | visual |
| Galena (collapsed) | shaft? | 18 Aug 97 | 6700 | | | T6SR10WS17SENW | visual |
| Joker (collapsed) | shaft? | 18 Aug 97 | 6900 | | | T6SR10WS18SESE | visual |
| Horn Silver | shaft | 26 Jul 98 | 6850 | | | T6SR10WS18NWSE | Anabat |
| +Goodview | shaft | 18 Aug 97 | 6885 | | | T6SR10WS18SWSW | Anabat |
| +Dexter (grated) | shaft | 18 Aug 97 | 6900 | | | T6SR10WS18SWSW | Anabat |
| +Carbonate | shaft | 18 Aug 97 | 7120 | | | T6SR10WS18SWNW | Anabat |
| Rena (collapsed) | shaft | 18 Aug 97 | 7060 | | | T6SR10WS18SWNW | visual |
| Boaz (collapsed) | shaft? | 18 Aug 97 | 6550 | | | T6SR10WS19NESE | visual |
| +Ermont #19<br>+Ermont #19 (grated) | pit<br>shaft | 18 Aug 97+<br>29 Sep 97<br>8 Jun 98 | 6560 | | | T6SR11WS35NENE | Anabat, Mist net<br>Anabat, Mist net |
| Ermont West ("Rebish adit") | shaft | 18 Aug 97<br>8 Jun 98 | 6560 | | | T6SR11WS35NENW | Anabat<br>Anabat, Harp trap |
| Ermont East (grated) | shaft | 8 Jun 98 | 6490 | 45° 16' 11" | 112° 54' 22" | T6SR11WS35SENE | Anabat |
| +Ermont #2 (grated) | adit | 18 Aug 97+<br>8 Jun 98 | 6400 | | | T6SR11WS35NWSE | Anabat<br>Anabat, Mist net |
| +Nick Preen | adit | 25 Aug 97 | 7340 | | | T6SR12WS14NESE | Anabat |
| +Agnes Load | adit | 25 Aug 97 | 7640 | | | T6SR12WS14NENW | Anabat |
| Little Hawk (collapsed) | pit | 25 Aug 97 | 7950 | | | T6SR12WS15NENE | visual |
| Mayflower | shaft | 25 Aug 97 | 7500 | | | T6SR12WS22SWSE | visual |

Table 1 (cont.) Mine sites surveyed for potential/actual use by bats in southwestern Montana during 1997-1998 Sites with evidence of bat activity are indicated with a "+", mine workings inspected internally are marked with a "*".

| Mine Site | Type | Date | Elev (ft) | Lat. (N) | Long. (W) | Legal TRS | Survey Method |
|---|---|---|---|---|---|---|---|
| +Sunrise #2 | adit | 25 Jul 98 | 7160 | | | T6SR12WS24SENW | Anabat, mist net (guano) |
| Unnamed Prospect | pit | 7 Aug 98 | 8180 | | | T7SR3WS15SWSE | visual |
| Ermont South (grated) | shaft | 9 Jun 98 | 6790 | 45° 15' 27" | 112° 55' 13" | T7SR11WS2SENW | visual |
| Opy (grated) | shaft | 9 Jun 98 | 6350 | 45° 14' 44" | 112° 54' 59" | T7SR11WS11NENW | visual |
| Unnamed (collapsed) | shaft? | 9 Jun 98 | 6350 | | | T7SR11WS11NWSW | visual |
| Bonnie Group (collapsed) | adit? | 20 Aug 97 | 7200 | | | T7SR11WS15SWSW | visual |
| Stevenson (collapsed) | adit? | 20 Aug 97 | 7150 | | | T7SR11WS27SENE | visual |
| +Leonnie's Tunnel (grated culvert) | adit | 19 Aug 97 | 6560 | | | T7SR11WS28SESE | Anabat |
| +Huron/Cottontail A | shaft | 20 Aug 97+ | 6950 | | | T7SR11WS28NWSE | Anabat |
| Huron/Cottontail B | shaft | 24 Jul 98+ | 6900 | | | | Anabat |
| +Huron/Cottontail C (cable net) | adit | | 6700 | | | | Mist net |
| +Huron/Cottontail D | shaft | | 6720 | | | | Mist net |
| +Huron/Cottontail E (grated) | shaft | | 6720 | | | | Mist net |
| Huron/Cottontail (cable net/grated) | shafts (4) | | 6700 | | | | visual |
| | adits (1) | | | | | | visual |
| Huron/Cottontail (open) | shafts (4) | | 6700 | | | | visual |
| +Pomeroy A | adit | 20 Aug 97 | 6700 | | | T7SR11WS28NWNW | Anabat |
| +Pomeroy B | shafts (2) | | | | | | Anabat |
| +Kent/Bluewing B | adit | 19 Aug 97+ | 7000 | | | T7SR11WS33NWNE | Anabat |
| Kent/Bluewing C | adit | 30 Sep 97+ | 6740 | | | | Mist net |
| +Kent/Bluewing D | adit | 24 Jul 98+ | 6740 | | | | Anabat, Mist net |
| +Kent/Bluewing E (cable net) | adit | | 7030 | | | | Anabat, Mist net |
| +Kent/Bluewing F (cable net) | adit | | 7070 | | | | Anabat, Harp trap |
| Kent/Bluewing (grated) | shafts (2) | | | | | | visual |
| +*Hendricks (gated) | adit | 21 Aug 97+ | 6000 | | | T8SR11WS7NENW | Anabat |
| | | 12 Jun 98 | | | | | Anabat, Harp trap |
| | | 13 Jun 98+* | | | | | visual |
| | | 4 Sep 98* | | | | | visual |
| | | 4 Dec 98+* | | | | | visual |
| +Hendricks (Suffield portal) | adit | 21 Aug 97+ | 6200 | | | T8SR11WS7SWNW | Anabat, Mist net |
| | | 12 Jun 98+ | | | | | Anabat, Mist net |

Table 2. Bats captured (mist-net or harp trap) or observed in 1997-1998 during abandoned mine surveys on BLM lands in Beaverhead, Madison, and Silver Bow counties, southwestern Montana.

| Mine Site | Type | Location | Date | Species[1] | Sex |
|---|---|---|---|---|---|
| Unnamed | adit | T2SR6WS10SWNW | 19 Aug 98 | MYCI | 5M |
| Gold Rod #1 | adit | T2SR6WS22NENE | 10 Jul 98 | MYCI | 1M |
| Beacon Light | adit | T2SR7WS31SWSE | 30 Jun 98 | MYCI | 1M |
| Jackrabbit | adit | T2SR8WS21NESW | 6 Jul 98 | MYCI | 1M |
| Tidal Wave B | shaft | T3SR5WS28NENW | 10 Jul 98 | MYEV | 1M |
| Plainview B | adit | T3SR5WS28NWNW | 11 Jul 98 | COTO | 1?* |
| Unnamed | adit | T3SR7WS8SESE | 11 Jun 98 | MYCI<br>COTO | 5M, 3F<br>1M |
| Unnamed Gold Deposit #2 | adit | T4SR4WS32SENE | 3 Sep 98 | MYCI | 1M* |
| Unnamed Gold Deposit #3 | adit | T4SR4WS32SENE | 24 Jul 98 | MYCI | 2M |
| Union #4 | adit | T4SR5WS3SENE | 11 Jul 98 | MYCI<br>COTO | 2M<br>1M |
| Unnamed | adit | T4SR8WS7SWNW | 7 Aug 98 | MYCI | 2M |
| Unnamed | adit | T4SR8WS18SENW | 6 Aug 98 | MYCI<br>MYEV | 5M<br>1F |
| | | | 17 Aug 98 | MYCI<br>MYEV | 5M<br>1F |
| Ermont #19 | pit | T6SR11WS35NENE | 18 Aug 97 | MYCI | 5M, 1F |
| Huron/Cottontail C | adit | T7SR11WS28NWSE | 20 Aug 97 | MYCI<br>MYEV | 1M<br>2M |
| Huron/Cottontail D/E | shaft | T7SR11WS28NWSE | 20 Aug 97 | MYCI | 2M |
| Kent/Bluewing D | adit | T7SR11WS33NWNE | 19 Aug 97 | MYCI<br>MYEV | 3M<br>1M |
| Kent/Bluewing E | adit | T7SR11WS33NWNE | 24 Jul 98 | MYEV<br>EPFU | 3M<br>1M |
| Kent/Bluewing F | adit | T7SR11WS33NWNE | 24 Jul 98 | MYCI | 1M |
| Hendricks (Suffield adit) | adit | T8SR11WS7SWNW | 21 Aug 97 | MYCI | 2M |
| Hendricks (gated adit) | adit | T8SR11WS7NENW | 13 Jun 98 | MYCI | 1F* |
| | | | 4 Dec 98 | MYCI<br>EPFU | 1?*<br>1?* |

[1] MYCI (*Myotis ciliolabrum*), MYEV (*M. evotis*), EPFU (*Eptesicus fuscus*), COTO (*Corynorhinus townsendii*).

* Observed during internal survey.

Table 3. Bats detected with ANABAT ultrasound monitors in 1997-1998 on BLM lands in Beaverhead, Madison, and Silver Bow counties, southwestern Montana. Species assignments are tentative. Number of passes in parentheses, sites with equipment malfunction marked with *

| Mine Site | Type | Location | Date | Species[1] |
|---|---|---|---|---|
| Strawberry D<br>Strawberry E | shaft<br>shaft | T2SR3WS14SENW | 17 Sep 97 | MYSP(1)<br>MYSP(5) |
| Mohawk A<br>Mohawk B | adit<br>shaft | T2SR6WS10SENW | 25 Sep 97 | MYSP(5), MYEV(6)<br>MYSP(4) |
| Gold Rod | adit | T2SR6WS22NENE | 10 Jul 98 | UNKN(1), MYSP(13), MYEV(1) |
| Watseca | shaft | T2SR7WS31SENE | 6 Aug 97 | MYSP(5) |
| Champion | shaft | T2SR7WS31NESE | 6 Aug 97 | UNKN(1), MYSP(7), EPFU(1) |
| Dick & Billy Jane | shaft | T2SR7WS31NESW | 6 Aug 97 | MYSP(17) |
| Camp Creek | adit | T2SR8WS11NENW | 1 Jul 98 | UNKN(#?) |
| Maiden Rock | adit | T2SR9WS5NENE | 5 Aug 97 | UNKN(1), MYSP(1) |
| Unnamed N. Helene | shaft | T3SR1ES19NENW | 8 Aug 98 | UNKN(2), MYSP(3) |
| Helene | adit | T3SR1ES19NENW | 8 Aug 98 | UNKN(4) |
| Plainview A | adit | T3SR5WS28NWNW | 11 Jul 98 | MYSP(3), MYEV(12) |
| Tidal Wave A<br>Tidal Wave B* | adit<br>shaft | T3SR5WS28NENW | 10 Jul 98<br>23 Sep 97 | UNKN(6)<br>MYSP(2), EPFU(1) |
| Falcon Prospect* | shaft | T3SR5WS34NESW | 24 Sep 97<br>10 Jul 98 | MYSP(3)<br>UNKN(1) |
| Walker | shaft | T3SR5WS34NWSW | 24 Sep 97 | MYSP(11), EPFU(1) |
| Black Ace #1<br><br>Black Ace #2* | adit<br><br>adit | T3SR5WS34NWNE<br><br>T3SR5WS34NWNE | 24 Sep 97<br>22 Jul 98<br>22 Jul 98 | MYSP(5), MYEV(1)<br>UNKN(5)<br>UNKN(1), MYSP(1), LANO/LACI(1), EPFU(2) |
| Germania 2<br>Germania 4 | adit<br>shaft | T3SR7WS3NWSW | 28 Jun 98 | UNKN(1), MYSP(1), MYEV(1)<br>UNKN(2), MYSP(1) |
| Emma C | shaft | T3SR7WS6SESW | 15 Oct 97 | MYSP(1) |
| Unnamed | adit | T3SR7WS8SESE | 9 Jun 98 | UNKN(7), MYSP(1), MYEV(1) |
| Gold Seal | shaft | T3SR7WS8SWNE | 11 Jun 98 | UNKN(1) |
| Eclipse | shaft | T3SR7WS8SWNE | 11 Jun 98 | UNKN(1) |
| Shoemaker A<br>Shoemaker H | shaft<br>shaft | T3SR7WS8SWNW | 1 Oct 97 | MYSP(9)<br>MYSP(3), COTO?(1) |
| Unnamed shaft | shaft | T3SR7WS18NENE | 11 Jun 98 | UNKN(1), MYSP(5) |
| Unnamed | shaft | T3SR7WS33NESW | 29 Jun 98 | UNKN(18), MYSP(158), MYEV(10), EPFU(1) |
| Ajax | shaft | T3SR8WS1NWNW | 30 Jun 98 | MYSP(1) |
| Unnamed Gold deposit | adit | T4SR4WS32SENE | 23 Jul 98 | MYEV(2) |
| Unnamed | adit | T4SR8WS7NWNW | 6 Aug 98 | UNKN(30), MYSP(36) |
| Unnamed | adit | T4SR8WS7SWNW | 7 Aug 98 | UNKN(6) |
| Goodview | shaft | T6SR10WS18SWSW | 18 Aug 97 | MYSP(5), LANO(1), COTO(2) |
| Dexter | shaft | T6SR10WS18SWSW | 18 Aug 97 | UNKN(3), LANO(1), EPFU(20), COTO(3) |
| Carbonate | shaft | T6SR10WS18SWNW | 18 Aug 97 | MYSP(12) |
| Ermont #19 | shaft | T6SR11WS35NENE | 18 Aug 97 | MYSP(100), MYEV(35), COTO?(10) |
| Ermont #2 | adit | T6SR11WS35NWSE | 18 Aug 97 | MYSP(4), EPFU(5) |
| Nick Preen | adit | T6SR12WS14NESE | 25 Aug 97 | EPFU(1) |
| Agnes Load | adit | T6SR12WS14NENW | 25 Aug 97 | EPFU(5) |
| Leonnie's Tunnel | adit | T7SR11WS28SESE | 19 Aug 97 | MYSP(6) |

[1] UNKN (unknown bat species), MYSP (*Myotis* species), MYEV (*M. evotis*), EPFU (*Eptesicus fuscus*), COTO (*Corynorhinus townsendii*), LANO (*Lasionycteris noctivagans*), LACI (*Lasiurus cinereus*)

Table 3 (cont.). Bats detected with ANABAT ultrasound monitors in 1997-1998 on BLM lands in Beaverhead, Madison, and Silver Bow counties, southwestern Montana. Species assignments are tentative. Number of passes in parentheses, sites with equipment malfunction marked with *.

| | | | | |
|---|---|---|---|---|
| Huron/Cottontail A* | shaft | T7SR11WS28NWSE | 20 Aug 97 | MYSP(2), EPFU(4) |
| Huron/Cottontail D | shaft | | 24 Jul 98 | UNKN(5) |
| Pomeroy A | adit | T7SR11WS28NWNW | 20 Aug 97 | MYSP(2) |
| Pomeroy B | shaft | | | MYSP(13), MYEV(2), LANO/LACI(1), COTO?(1) |
| Kent/Bluewing B* | adit | T7SR11WS33NWNE | 19 Aug 97 | MYSP(29), EPFU(9) |
| Kent/Bluewing D | adit | | 30 Sep 97 | MYSP(4) |
| Kent/Bluewing E | adit | | 19 Aug 97 | UNKN(6), MYSP(50), EPFU(20) |
| | | | 30 Sep 97 | MYSP(3) |
| Kent/Bluewing F | adit | | 19 Aug 97 | UNKN(6), MYSP(14), MYEV(1), COTO(13) |
| | | | 30 Sep 97 | MYSP(3), MYEV(2) |
| Hendricks (gated) | adit | T8SR11WS7NENW | 21 Aug 97 | UNKN(23), MYSP(104), COTO(27) |
| Hendricks (Suffield) | adit | T8SR11WS7SWNW | 12 Jun 98 | UNKN(1) |

[1] UNKN (unknown bat species), MYSP (Myotis species), MYEV (M. evotis), EPFU (Eptesicus fuscus), COTO (Corynorhinus townsendii), LANO (Lasionyteris noctivagans), LACI (Lasiurus cinereus).

Table 4 Mine workings surveyed internally (partially or completely) in southwestern Montana in 1998 Sites with data loggers installed are indicated with a "+"

| Mine Site | Elev. (ft) | Type | Survey Date | Underground Extent (ft) | Max. Temp. (F) | Bats Present[a] |
|---|---|---|---|---|---|---|
| +Ruth & Copper Bottom | 7400 | simple adit | 2 Sep | 183 | 50 | none |
| Plainview A | 5680 | simple adit | 11 Jul | 35 | 69 | 1 COTO |
| +Unnamed (T3SR7WS8SESE) | 5860 | simple adit | 11 Jun, 2 Sep | 186 | 57.5 | none |
| Gold Seal | 5880 | simple decline | 2 Sep | 120 | --- | none |
| Eclipse | 5880 | multilevel decline | 2 Sep | >500 | --- | none |
| Unnamed Gold Deposit #2 | 5800 | multilevel decline | 3 Sep | >100 | --- | none |
| Unnamed Gold Deposit #3 | 5800 | multilevel adit | 3 Sep | >300 | 49 | 1 MYCI (dead) |
| +Union #4 | 5920 | multilevel adit | 1 Sep | >500 | 62 | none |
| Union #5 | 5920 | simple adit | 1 Sep | 139 | 59 | none |
| +Unnamed (T4SR8WS7SWNW) | 5800 | simple adit | 3 Sep | 134 | 47 | none |
| +Unnamed (T4SR8WS8SENW) | 5640 | multilevel adit | 3 Sep | 271 | 51 | none |
| +Hendricks (gated) | 6000 | multilevel adit | 13 Jun, 4 Sep, 4 Dec | >2000 | 54 | 1 MYCI (Jun); 1 MYCI, 1EPFU (Dec) |

[a] MYCI (*Myotis ciliolabrum*), EPFU (*Eptesicus fuscus*), COTO (*Corynorhinus townsendii*).

Figure 1. The elevational distribution of two categories of mine workings (adits, shafts: see methods for definitions) in southwestern Montana that were monitored in 1997-1998. Sample sizes are indicated above each bar.

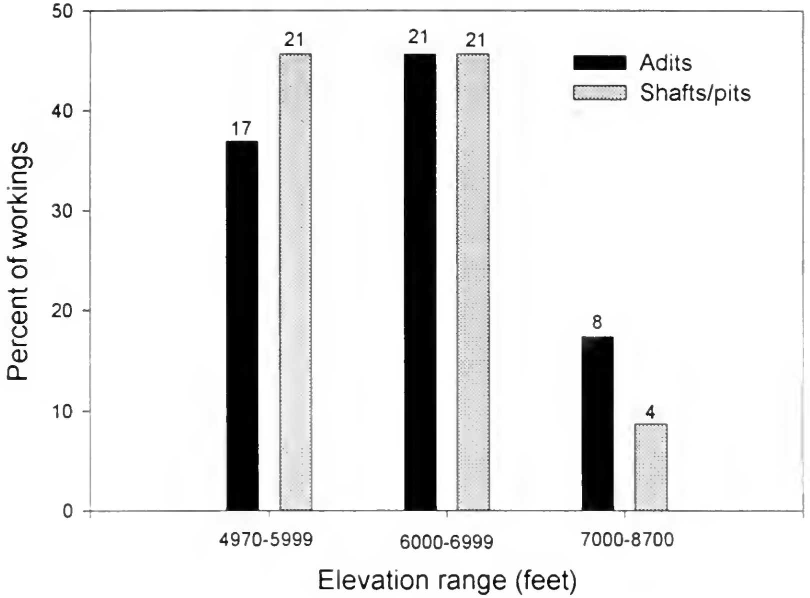

50
40
30
20
10
0
Percent of workings
21
21
21
17
8
4
Adits
Shafts/pits
4970-5999
6000-6999
7000-8700
Elevation range (feet)

Figure 2. The influence of elevation on the use of monitored mine sites by bats ("used" or "not used" classification is based on captures, sightings, ANABAT, or droppings). Collapsed mines are not included in the samples. Sample sizes are indicated above each bar.

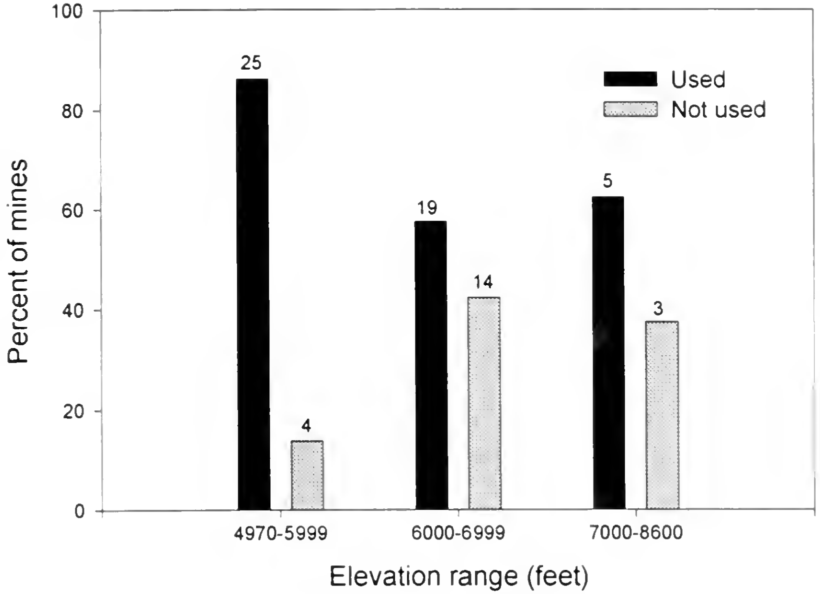
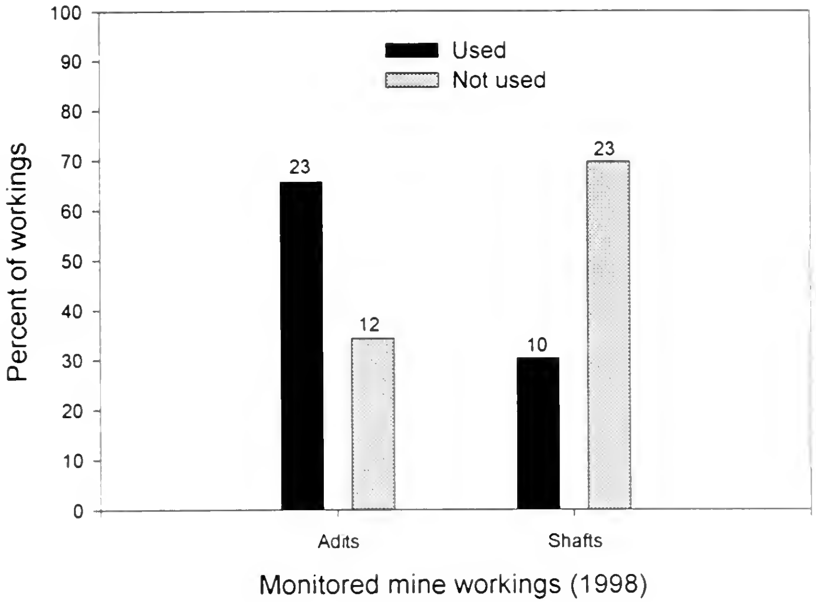

Used
Not used
25
4
19
14
5
3
100
80
60
40
20
0
Percent of mines
4970-5999
6000-6999
7000-8600
Elevation range (feet)

Figure 3. The influence of mine working type (adit or shaft) on their use by bats in 1998. "Used" or "not used" classification is based on captures, sightings, ANABAT, or droppings. Sample sizes are indicated above each bar.



Used
Not used
Percent of workings
0
10
20
30
40
50
60
70
80
90
100
23
12
10
23
Adits
Shafts
Monitored mine workings (1998)