ASSESSMENT OF INACTIVE MINES AS BAT HABITAT IN NORTHERN IDAHO: SUMMARY OF BLM RESEARCH 1994-99.

by

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INTRODUCTION

Federal Lands in Idaho contain an estimated 5,000 inactive or abandoned mine sites, many with open portals. Human intrusion into these mines, whether motivated by curiosity or historical interest, subjects individuals to a variety of hazards that can prove life threatening. Consequently, inventory and closure of inactive and abandoned mines has received increased emphasis. Bats, many of which traditionally use caves and old-growth forests to roost and hibernate, may have become dependent on old mines (Tuttle and Taylor 1994). Recent colonization of mines developed during the past century could be the result of an expansion of bat habitat through selective processes enhancing metapopulations (McCullough 1996) or bats may have been displaced from their native habitat into mines as alternative roosting sites. Additionally, some species may enter mines to feed on insects accumulating near the back at the portal. Irrespective of the factors that have caused mine use, the loss of mine habitat through closures may threaten a number of species that now appear to be mine obligates. One of these species, Townsend's big-eared bat (*Corynorhinus townsendii*), is generally considered the most sensitive species occupying mines in Idaho (Pierson et al. 1999).

States such as Colorado have developed survey guidelines (Navo 1994) and volunteer team training manuals (Sheppard et al. nd) to assess the bat value of inactive mines. In Idaho, the Bureau of Land Management (BLM) and the Forest Service have developed an integrated approach for locating old inactive mine sites, but they have not developed a cooperative program aimed at completing biological surveys of sites slated for closure. Preliminary guidelines for the assessment of bat habitat have been prepared for the Panhandle National Forest (Keller, manuscript) because this Forest has generated an aggressive program of bat-friendly mine closures, especially at sites adjacent to Lake Pend Oreille (Keller 1997c).

A pilot inventory and mapping of inactive and abandoned mine lands (see McNary et al. nd) was funded by both the Forest Service and BLM as a result of the heavy metal contamination in the East Fork of the Pine Creek Watershed of the Silver Valley. While this inventory was in progress, the BLM sought help developing information on bat species occurring on lands they administer. The following study was initiated independently of the mine inventory to determine the suitability of inactive Silver Valley mines as potential bat habitat. The present report summarizes: 1) a research assessment of selected mine sites containing adits that could serve as summer roosting or winter hibernal habitat for bats, 2) an assessment of the species using some of these mines, and 3) characterizes the thermal envelope of several mines in the Silver Valley. The results presented here are part of an inventory of bat species being studied by the author in northern Idaho.

Most of the sites reported upon here were located on BLM lands in the Greater Coeur d'Alene mining region, an area largely bounded at the eastern edge near Mullan to the western edge near Pinehurst. Appropriate information was also gathered at other localities deemed to be important historical bat habitat. Annual reports prepared for the first three years of research effort remain unpublished (Keller 1995b; 1996; 1997a). This technical report summarizes the results of these studies and provides additional information gathered since the third report appeared in 1997.

METHODS

Taxonomic Placement and Species Sensitivity

The nomenclature of species expected in northern Idaho was assessed from Hall (1981), Van Zyll de Jong (1984) and Jones et al. (1992), including species names updated from the nomenclature in Hall (1981) by Frost and Timm (1992), and Tumlison and Douglas (1992). Frost and Timm (1992) restored the traditional generic name of Townsend's big-eared bat from *Plecotus* (see Handley 1959) to *Corynorhinus*, a standard used in this report. Species expected in the study area, as assessed from the literature on bats and on the basis of specimens held in museum collections containing Idaho bats, or on the basis of previous studies in the Panhandle National Forest (Keller and Doering 1995) included the pallid bat (*Antrozous pallidus*), see Fichter (1964), big-brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), California Myotis (*Myotis californicus*), western small-footed Myotis (*Myotis ciliolabrum*), long-eared Myotis (*Myotis evotis*), little brown Myotis (*Myotis lucifugus*), fringed Myotis (*Myotis thysanodes*), long-legged Myotis (*Myotis volans*), Yuma Myotis (*Myotis yumanensis*), and Townsend's big-eared bat (*Corynorhinus townsendii*).

Keller (1985) published a key to the bats of Idaho that reviews most of the morphological characteristics permitting identification of the above species. Since the report on the first year of the present study was prepared for northern Idaho (Keller 1995b), new bat species were added to the Conservation Data Center, Idaho Department of Fish and Game, Sensitive Species list, and Groves et al. (1997) added global rankings (Master 1991) to document the status of Idaho bats. These rankings, developed after the 1996 elimination of the "C" series classification for vertebrate species by the U.S. Fish and Wildlife Service, need to be considered in relation to proposed mine closures. In Idaho, Townsend's Big-eared bat (*Corynorhinus townsendii*), is listed as an S2 (imperiled because of rarity) species by Fish and Game and as a sensitive species by the BLM. Long-eared Myotis (*Myotis evotis*), Long-legged Myotis (*M. volans*) and Yuma Myotis (*M. yumanensis*), unprotected non-game species, are listed as Idaho S3 species (rare or uncommon), but the latter species are ranked G5 globally, suggesting they are secure nationally (Groves, et al. 1997). The BLM lists these species as sensitive, however. By contrast, California Myotis (*M. californicus*) are listed as S1 (critically imperiled because of extreme rarity only by Fish and Game). Of the former species, *Corynorhinus townsendii*, listed as a G4 species, *M. californicus*, rare, and *M. thysanodes* should be considered sensitive in the study area because of their uncommon occurrence. The habitats of these species need protection to prevent elimination of local populations. The status and distribution of Fringed Myotis (*M. thysanodes*), a protected non-game species with a Global rank of G5, a state rank of S1, and a BLM sensitive status, is poorly known for the state of Idaho. This species has been collected within the area of study. Other species expected in caves or trees in the study area, as assessed from Hall (1981), on the basis of specimens held in museum collections containing Idaho bats, or on the basis of previous studies in Northern Idaho (Keller and Doering 1995), are detailed elsewhere and appear secure.

Study Preparation and General Procedures

Preliminary evaluation of bats species found in northern Idaho was completed by Keller and Doering (1995), who assessed specimens held in a variety of national museums and sampled some sites largely on Forest Service parcels. Prior to field assessments started in 1994, special attention was given to

specimens collected in the portion of Washington adjacent to and in northern Idaho that were deposited at the Conner Museum, Washington State University. The majority of the work reported in this summary volume occurred at sites in the Silver Valley but during the first year of study, mines near Clark Fork (not on BLM managed lands) were assessed as a result of an adit known historically to support Townsend's big-eared bats (*Corynorhinus townsendii*). The other portion of the 1994 sampling of bats with mist nets and assessment of mine sites that might support bats was completed within driving distance of I-90, the main travel corridor in the Silver Valley, and in the Clark Fork area (see Fig 1). Nets employed at mines were removed shortly after mine utilization was documented to permit bats to freely enter and exit night roosts. In general, netting was terminated at least 1 to 2 hours after full darkness. In all cases including assessment of mines that were entered during this and subsequent years, drifts (see mining terminology review, Appendix A) were searched for sign of bat use including insect parts deposited on standing water or guano deposits on mine ribs and sills. Acoustic activity of bats was monitored at sampling sites to assess activity levels during net samplings and to gather information on potential *Corynorhinus* avoiding capture during 1994 only. Field work was conducted by Keller, Bosworth and Doering during the first year of study. Keller and Saathoff during the second year of study expanded the assessment of field sites in both the Silver Valley and the area near the town of Murray, Idaho (see Fig. 2). Keller completed all additional field work from 1996-1999, concentrating largely on previously investigated areas. The results of these studies have been segmented in this summary report from the annual reports (Keller 1995b, 1996 and 1997a). Additional data have been added for unreported mine searches and for thermal profiles prepared for BLM properties collected until July, 1999. Table 1 provides a listing of the dates that each site was visited from 1994-1999. Site mapping is shown in Appendix B.

Clark Fork Summer Research, 1994

Two sites in the Clark Fork area were examined for bat species as a result of research by Keller and Doering (1995). Site 2, a slack water area on Lightning Creek was netted with a single 110 d/2 ply four shelf 2.6 m high, 12 m long, 36 mm (7 by 42 foot, 2 3/8 inch) mesh black nylon mist net suspended over a water on Lightning Creek. The adit where *Corynorhinus townsendii* have been sighted (site 1) was netted during the same time. At the termination of field work in the Silver Valley undertaken during 1994, additional mines were located in the Clark Fork area (see sites 32-35) and two portals were subsequently netted in an attempt to expand the search for plecotine bat habitat.

Silver Valley Summer Research, 1994

Summer field collection was proceeded by two days of site selection. Thirty-two unworked mine sites (Table 1) were located with the aid of Mr. Donald C. Springer, a geologic consultant residing in Osburn, who graciously accompanied myself, Bill Bosworth, and William Doering during the site selection process. United States Geological Survey quadrangle maps, marked with locations of mines believed to occur on BLM lands, were largely used to select sites accessible by road or short hike. In some cases, mines on patented claims were visited as a result of potential reversion to federal ownership or when the ownership was not clear. Additionally, several portals were located on BLM lands that were not shown on maps provided, some adits were searched for that were later determined to be incorrectly located in the BLM data base, and some adits were selected as a result of their accessibility that were on Forest Service lands. Because many species of bats do not show perfect fidelity to specific mines, this method of survey was deemed justifiable on biological grounds as a result of the mobility of individual species. The

species of primary interest, *Corynorhinus townsendii*, suggested to exhibit strong fidelity during hibernation (Humphrey and Kunz 1976; Wackenhut 1990) likely demonstrates weak fidelity to summer roost sites (Keller et al. 1993), as a result of shifting locations of prey populations. Further, field studies have suggested big-eared bats may vary nursery sites located in lava-tube caves occupied in southern Idaho (Keller and Saathoff 1995). I assumed that although bat census techniques yield the best results where bat densities are likely to be high, such as in localities serving as day roosts or winter hibernacula, most mines used during evenings (night roosts) would be used temporarily by Townsend's big-eared bats or other species following foraging bouts and prior to late-night return to final day roost sites. Such a pattern would also likely produce moderate densities at any single site.

Thirty-three sites were investigated by day visitation for bats and potential night-roost netting. Mines with openings not permitting entrance by walking individuals, either containing partially collapsed entrances (dangerous access sites: 11, 13, 16, 26, 27), no means of entering (blocked access sites: 4, 5, 7, 9, 10, 14, 17, 19, 20, 21, 22, 23, 24, 25), or that were behind locked gates, most of which likely excluded bats (locked sites: 3, 6, 8, 18, 22), were excluded from consideration. Mines with narrow or partially collapsed openings that could be entered by individuals wearing a half-mask air-purifying respirator equipped with HEPA filters were not entered as a result of other safety considerations. Finally, most entered portals in the Silver Valley (12, 15, 16-winter only, 28, 29, 30) contained visually sighted *Peromyscus maniculatus* and *Neotoma* sp. populations, known primary reservoirs for hantavirus infection. Because death may result from infections of humans by this virus (CDC 1993), partially collapsed openings were not entered as a result of assumed limited air exchange, a condition permitting potential aerosol infection of individuals.

A total of five mine adits in the Silver Valley, assessed visually during daylight hours and found not to contain day-roosting bats, were selected to be sampled for night-roosting during evening hours. The main limitation of mist netting mines during evening hours occurs as a result of twilight conditions permitting bats to detect and avoid nets. This can result in low overall capture success and in some cases sampling bias where one species is better able than another to detect the nets because it flies earlier. At some locations bats were noted in the air column beyond the reach of standard netting procedures and some individuals were seen skirting nets. Additionally, the size of the portal opening and the duration of sampling intervals proved too variable to contrast numerical abundance between locations. But consistency of species represented within areas, especially among years (see ahead), suggested that the samples obtained represent most bat species roosting in mines in the Silver Valley. Additionally, analysis of ultrasonic recordings failed to establish the presence of big-eared bats that were avoiding areas being netted.

Winter Research 1995

A mid-winter investigation was completed on six mines during March, to assess winter hibernation in the study area. Careful visual searches were completed at site 12a (Constitution Mine), site 15 (Rock Creek Mine), and site 28 (International Mine), along ribs (walls) and mine backs (ceilings). Summer assessments suggested these mines might be used during winter. All contained some free-standing water on the floor during the assessment. Three smaller mine adits: 1, 16, and 29 were also checked.

Summer Research, 1995

Prior to initiating field work for the second season, a decision was made not to retain representative specimens of bats collected or observed unless voucher specimens or other museum data were not already

available for a species collected in the study area. The focus of the field work, undertaken during the second year of study, involved locating inactive mines with open portals, assessment of day roosting at these sites, and locating potential new sites for mid-winter counts of bats occupying mines. Safety precautions including a Passport Air Monitor were employed during all adit searches. Sites were investigated from 16-22 August 1995, by white light during daylight hours to locate roosting bats or sign.

Field work involved reviewing mines along roads that could be driven and locating mines that could only be reached by trail bike. Seven mines near the town of Murray were evaluated to extend the scope of the study north of the Silver Valley. An additional 28 inactive mine sites were sought in areas partly studied during the first year of study (# and quads: 1-Kellogg West; 9-Masonia; 9-Osburn; 4-Polaris Peak; and 5-Twin Crags). All five Twin Crags sites were reached by trail bike. In 35 searches, 24 mines sites were located yielding only 8 open portals. Three sites were netted in the evening.

Winter Research, 1996.

During 8-9 January 1996, eight mines were searched for hibernating bats. A re-evaluation of winter use of Sites 1 (Ruen Adit), 15 (Rock Creek Mine), 28 (International) and 29 (Patricia Adit) was completed during 10-13 March 1996, when portals were only accessible by snowshoe. In the Clark Fork Area, mine 1 was checked for bats on 13 March, and a new site, portal 7 of the Lawrence Mine, which is on Forest Service land and is partially sealed with bat friendly gates, was checked for bats on 29 March.

Summer Research, 1996.

Assessment of Mines

Summer sampling, completed from 30 July to 5 August was limited to the re-assessment of bat species using site 28 (International Mine) as a night roost, evaluation of two new sites (Louisiana Pacific Exchange Adit-not mapped as removed from BLM ownership) and the Sunset Minerals Mine (traversed to face during daylight hours) as potential bat habitat in the Silver Valley, and searches of one mine in the Clark Fork area (Lawrence Mine-FS, not shown on maps).

Temperature Evaluation of Mines

Four mines, two on BLM lands in the Silver Valley, and site 1 (=Rune Adit) and Lawrence Mine near Clark Fork were considered important night roost or hibernal sites. During two winters of assessment, no Silver Valley mines had been located that contained hibernating bats whereas a Clark Fork site did. A study thus was undertaken to assess the temperature variation inside these mines for contrast to the Rock Creek mine and the International mine in the Silver valley, two mines being considered for placement of bat-friendly gates. During mid-summer, five StowAway temperature loggers complete with sensor probes (Onset Computer Corporation, Pocasset, MA) were installed at the Rock Creek Mine, International Mine, Ruen Adit, and Lawrence Mine (see Keller 1997a). The sample interval was set for either 260 or 360 consecutive days which resulted in a window of time between samples ranging from 3 hours 12 minutes to 4 hours and 48 minutes during the first 30 days of deployment. All these StowAway loggers recorded in the range of -39 to +122 degrees centigrade. A review of the data obtained from the Clark Fork loggers is provided in Keller (1997a). The present report summarizes data from the two Silver Valley BLM localities gathered until 1999, and data gathered at a later date from one Silver Valley mine (Big It Mine).

In a study initiated at Craters of the Moon National Monument during 1996 (Keller 1997b and 1999), I found thermal loggers failing before the termination of preset sampling intervals as a result of moisture

corrosion of the battery terminals powering the data storage chip. Upon consultation with Onset Computer, I returned to the Silver Valley in early September to check the loggers and found similar failures. Four of five loggers were removed and replaced with StowAway XTI internal/external temperature loggers scaled to a range of -37 to +46 degrees centigrade. Unfortunately, the Lawrence mine logger already had failed. The StowAway XTI chip permits greater storage of data, so the sampling interval was reduced to a range of one hour or less per measurement. Three loggers were placed in submersible (waterproof) cases for installation, but the loggers in the Rune Adit and Rock Creek Mine would have been visible in such cases and subject to theft. These loggers were obscured in drill holes near the back of the mine, a process quickly discovered to produce thermal profiles for the adjacent rock matrix rather than the interior envelope of a mine. These loggers did not provide useful data and the two Rune loggers subsequently failed. Consequently, during the initial trials, winter thermal data were only valuable from loggers placed in Silver Valley mines.

In March, the sites were revisited to remove the data loggers for reading and to search for hibernating bats at the sample sites. Mines were reached on snowshoe or by "crust walking". All loggers were replaced with waterproof 32 K Optic StowAway waterproof temperature recorders scaled from -5 to +37 degrees centigrade. These loggers remained in use until 1999 to determine consistency of thermal profiles among years. At reading, data matrices were downloaded into an Excel spreadsheet and the beginning and ending measurements were "clipped" of all recorded data to the start of the nearest new day. This procedure was undertaken to remove inappropriate measurements during start-up and close-down procedures because the loggers could not be easily downloaded in wet mines in situ. Thermal profiles were prepared in both centigrade and Fahrenheit, the maximum and minimum temperatures were assessed, and the mean temperature for the recorded interval was computed. Vertical bars in the figures presented in the Results section indicate the first day of winter (21 December) and the first day of spring (20 March) to aid assessment of variability among mines.

Bat Sampling Effort, 1997-99

Sampling of bats was significantly reduced during the summer of 1997 as a result of funding limitations, especially for field research on the relationship between bats using trees and mines. Funds available from the Carron Endowment, developed to curate mammals deposited at the Idaho Museum of Natural History, were graciously made available to purchase waterproof Optic StowAway Temp data loggers (Onset Corporation), launched and read by a host computer. Sequential placement of these devices in three Silver Valley Mines permitted evaluation of the thermal envelope over a period of several years. In the following text, these data are provided in English units to permit rapid evaluation. A sabbatical leave from ISU also provided time to review new maps showing mine locations and mine names updated by the BLM.

RESULTS AND DISCUSSION

Clark Fork Area, 1994

Three mines sampled near Clark Fork were used as summer night roosts by Yuma Myotis (*Myotis yumanensis*) or both Yuma Myotis and little brown Myotis (*Myotis lucifugus*). Yuma Myotis and big-brown bats (*Eptesicus fuscus*) were netted over water at the Lightning Creek site. No *Corynorhinus* were collected. Two bats, deposited in the mammal collection at the Conner Museum, Washington State University, were collected in "Clark Fork" on 30 July 1947. Both specimens, although unsexed, appear to be males. Unfortunately, the exact site of collection is unknown. Ken Kinucan, Director of the University of Idaho Field Campus, Clark Fork, had seen big-eared bats in the 70-foot adit east of Clark Fork (site 1), an adit I checked a number of times (Keller and Doering 1995) during separate visits in late summer and

November, 1989. No *Corynorhinus* were found. Shortly after the summer visit, Kinucan photographed a group of *Corynorhinus* in this adit and prepared two specimens, now on deposit at the Idaho Museum of Natural History, Pocatello. Both were unsexed but also appear to be males. His photograph and collection occurred 20 August 1989. This adit was netted and checked the end of July 1994, and did not yield *Corynorhinus*, yet six weeks later Kinucan twice found two *Corynorhinus* in the adit (Kinucan, personal communication, 14 September 1994). No *Corynorhinus* were observed at site 1 during my March 1995 return to this area. Because both netting and additional adits were sampled in the Clark Fork area during summer, and because all sightings had occurred during late summer, several tentative conclusions were initially formed: 1) the Ruen Adit does not house nursery colonies because, based upon its size, the temperature would be too variable and all observations or collections in it have occurred outside the known window of rearing young (Keller and Saathoff 1995); 2) this adit does not serve as a winter hibernaculum; and 3) this adit serves as a temporary summer roosting site; or 4) this adit serves as a staging area for males preparing to move to other areas. Based upon Kinucan's picture which shows clumped bats and the clustering of observations to periods starting from late July, the latter hypothesis was more appealing. Summer populations of *Corynorhinus townsendii* are known to be extensive in lower altitudes in Nez Perce County (Keller 1995a). Recently, they have been documented to occur in mines along the shoreline of Lake Pend Oreille and in mines in Boundary County (Keller 1997c). I concluded, because historical hibernacula occur along the Snake River on the Idaho-Oregon border, that the Clark Fork Adit contained individual bats that were moving to other more permanent hibernal sites. Thus, the term "staging area" was initially applied to this adit.

In spite of repeated field effort, winter hibernal sites had only been documented in desert areas in the southern half of Idaho until Keller (1997c) located hibernating Townsend's bats in two Boundary County mines and along Lake Pend Oreille. I initially assumed that cold weather produced the necessary and sufficient conditions for the long hibernating season that extends from November to April in southern Idaho (Keller et al. 1993) or in the more northern areas of the state. A potential hypothesis for the lack of observed hibernating populations in the Silver Valley was formed upon evaluation of the number of days of freezing temperature. *Corynorhinus* appears to require consistently cold temperatures (Doering 1996) to enter into hibernation. Data published by the National Climatic Data Center for stations located in Kellogg (2,320 feet) and Mullan (3,317 feet) suggest that the maximum number of days the temperature is below 32°F during at least 20 days of a given month are limited to November-March (see example Idaho NOAA data for 1994, ISSN:0145-0515). By contrast, bats hibernating in lava tubes in the Arco desert in southern Idaho, can hibernate from October until the end of April, expending less energy while waiting for insect populations to emerge because cold temperatures occur for a longer duration in this area (see weather data, Craters of the Moon National Monument (5,895 feet). Because insect populations are not available in March in the Silver Valley, early emergence would be energetically expensive and unlikely. This hypothesis excluded the possibility that bats may hibernate at higher altitudes in the Silver Valley or that populations may move to higher altitudes in areas adjacent to the Silver Valley. Consequently, further winter survey work should be undertaken in the Murray area during December or January before it can be concluded that plecotine bats do not occur in significant numbers on BLM lands in the Silver Valley or on BLM lands in the Murray area.

Silver Valley Area, 1994.

Both little brown bats and Yuma Myotis were collected while entering five mines sampled by net in the Silver Valley during summer. One fringed Myotis (*Myotis thysanodes*) was collected at site 30, and two California Myotis (*Myotis californicus*) were collected at site 15. The latter site was the first site to yield this species in northern Idaho. The Rock Creek mine consists of a very long tunnel. The gate was redesigned in late 1994 to permit space at the top and subsequently was locked to prevent human

intrusion. No bats were located in this mine in March 1995 during winter surveys. The Constitution Mine (12a), and sites 28 and 29, south of Pinehurst, did not contain bats during March either. Indeed, all adits checked did not yield hibernating individuals of any species. Gating is common in the Silver Valley. Minor modifications to the varied type of mesh steel gate encountered at some mines would likely expand bat night-roost habitat and could also be impacting winter hibernation.

Summer, Silver Valley and Extension Areas, 1995

No roosting bats or sign of bats were discovered in the eight open mines searched during daylight hours (quad and mine #: 64, 70 Burke; 54, 56, 62 Masonia; 48 Osburn; 22, 24 Twin Crags in the Silver Valley Area, or in mine 35 in the Clark Fork Area). The adit where *Corynorhinus townsendii* have been sighted (site 1) was assessed by direct observation during 22 August around 5:20pm. A single male *C. townsendii*, located on the mine back, was collected and released near the rear of the 70 foot adit. Daylight reaches this location. Three mine adits (California Mine, site 48BLM, Mother Load Mine, site 70PL, Hope Mine, site 35PL), assessed visually during daylight hours and found not to contain day-roosting bats, were selected to net night-roosting bats from dusk to full darkness. Bats were noted in the air column beyond the reach of standard netting procedures at these locations and some individuals evaded the nets at site 35. Activity was very limited at all three sites, however. No bats were captured.

Winter Assessment, 1996-Clark Fork Mines

Clark Fork site 1, was beginning to be constantly disturbed as evidenced by visual debris on the floor. Site #1 was checked on 9 January 1996, and found to contained single individual *Myotis lucifugus, M. ciliolabrum, M. evotis, Lasionycteris noctivagans*, and *Corynorhinus townsendii*. The adit was rechecked on 13 March 1996 by Saathoff, when it contained four *Myotis* sp. and one *Lasionycteris noctivagans*. The latter species does rest in mines during migration, but normally does not hibernate in them in Idaho. Because we did not disturb the bats observed in January, I do not know whether the silver-haired bat in the adit in March was the same individual.

By contrast, the slightly larger Whitedelf Mine (site 32) did not contain bats on 8 January. On the same date, the three upper adits of the Hope Mine could only be reached on foot as a result of impassible roads covered with snow. All of the portals were blocked by water on this date, making survey impossible. The main portal of this mine was not entered as a result of the unsafe condition of the lower levels of the mine and deep snow.

Because of the reduction in vegetative cover as a result of winter, the Northeast quarter of section 34 was searched for portals that were not located during previous field work. No old portals were located although there was ample evidence of mining activity in spoils and buildings.

In summary, the Hope Mine was considered too dangerous to fully traverse beyond the area just inside the main portal. Only the exploratory adit (Clark Fork #1), a short tunnel on private property, was found to contain hibernating bats. Because this adit is exposed to sudden changes in temperature as a result of its location and configuration, it was considered of major scientific interest. By 1996, hypotheses 2 and 4 (see above) appeared to apply to this adit, namely that it serves as both a staging area and winter hibernium.

Winter Assessment, 1996-Silver Valley Mines

Winter studies on bat populations in Idaho (Doering 1996; Keller 1997c) suggest that the distribution of hibernating individuals is largely clumped near the mouth of the entrance of a hibernium just beyond the twilight zone. Internal and potentially externally directed movement may occur during hibernation (Wackenhut 1990; Bosworth 1994), at least in desert habitat. All except one mine searched during 8 January 1996 (Mullan 16; Osburn 48 (new 95); Twin Crags 28, 29, 30) were fully traversed. The Rock Creek Mine (15), which consists of a single adit 4,707 feet long, was penetrated to a depth of 2,500 feet before the search was stopped for safety reasons. Snow depth during the winter of 1996 almost prevented accessibility to the Rock Creek Mine and the portal was partially closed by snow. Several inches to a foot of water was present on the floor to an internal depth of over 200 feet. The back and ribs were wet to this depth. This same mine was re-investigated 60 days later (14 March 1996) completely to the face and both short transverse drifts and no hibernating bats were located. Bats would still be in hibernation in March if present before this date.

No bats were found in the International Mine the first week in January or March, 1996, when thermal loggers were exchanged for reading. The entrance to this mine was half closed with snow, ice was present in the first 40 feet from the portal, and ankle-high water occurred within the first half of the adit beyond the portal. No water was present underneath the loggers. A drift on the left side of this mine, approximately 270 feet from the portal, contained water deeper than 12 inches near the raise above the left rib.

The Constitution Mine (Masonia 12a), traversed on 22 March 1995, to a machinery room used to control the shaft elevator, was not reached during field work conducted 8 January 1996, because the access road to the mine was destroyed by severe flooding.

Summer Assessment of Silver Valley Mines, 1996

International Mine

This mine is sufficiently complex (Fig. 3) to permit a variety of microhabitats. It also contains an inclined raise that extends to the surface at a point above the singular portal. When the portal was harp trapped for two nights on 30-31 July 1996, during poor weather, two *Myotis evotis* and two Little Brown Myotis (*M. lucifugus*) were collected between the period of 8:40 p.m. and 11:15 p.m. local time, and one *M. evotis* the following evening. All individuals were measured and sexed, three were banded on their forearms with split bands, and all were released on site. These bats were never visually observed during subsequent traverses or samplings at this mine.

Lawrence Mine

Jim Langdon, Panhandle National Forest Engineer, observed hibernating bats in this mine and initiated bat friendly closures of several portals during 1996. Other historical observations of bat occupancy have been mentioned by Ken Kinucan, Manager, Clark Fork Field Campus, University of Idaho. Although this mine is on Forest Service land, it was select as a study contrast to mines in the Silver Valley. Portal #2 was harp trapped for two nights, but no bats were collecting. No bats were found upon limited search of several drifts during August, September, or upon removal and replacement of thermal loggers on 29 March 1997.

Ruen Adit

During the summer 1996, a single *Myotus* sp. was found in a drill hole on 3 August during daylight hours, and a single *Corynorhinus townsendii* was found when a logger was replaced on 12 March 1997. Further assessments of this site were terminated as a result of theft of a data logger and because a transient individual was discovered living in the adit.

Mine Assessment during 1997-9

Big It Mine

The Big It mine, consisting of 1,250 ft-long adit, two winzes filled with water and a small stope was fully traversed on 10 July 1997, by myself during a mine safety field exercise. Bat sign (both moth wings and guano) was observed approximately 225 feet from the portal and a single day-roosting bat that was not captured but appeared to be a *Myotis* sp., was displaced at approximately 500 feet from the portal. This mine was harp trapped on 12 August, but no bats were seen entering, and no bats exited from 8:00 to 11:00 p.m. The Big It mine was also traversed on 17 January 1998, but no hibernating bats were observed.

Rock Creek Mine

Because the Rock Creek Mine was proposed to receive a bat-friendly gate (Keller 1997a), and had been traversed and sampled previously both during summer and winters, it was resampled on 13 August 1997, with a harp trap after the portal to the mine was sealed with black plastic curtain excepting the space occupied by the harp trap. Three bats were found to be day roosting in the mine. Two *M. californicus* were subsequently captured in the harp trap.

Constitution/Spokane Mine

This mine was netted and traversed in prior years. On 17 August 1997, it was harp trapped after a plastic curtain was used to cover all of the portal opening excepting the space occupied by the harp trap. Only a single *M. lucifugus* was captured.

Star Antimony Mine

This site had received prior review. On 16 August 1997, a 50d net secured on aluminum poles was placed over the portal of this mine. Several *Myotis* evaded capture and one *M. evotis* was captured by 11:00 p.m. The entire approximately 1300 feet of the adit open to the caved face was traversed on 27 October 1998, but no hibernating bats were found.

Sidney Mine

This mine was not reviewed until 27 October 1998. The mine consists of 800 feet of adit with a muck-filled left drift and a caved face on the right drift at the end of the adit. The back of this mine has a rough texture and is dry in places, so could be used by bats. The sill is covered with knee deep water in places. No bat sign or bats were observed on the water or ribs. Temperatures taken at the point of change from daylight to dark inside the adit (39-40°F) and at the caved area of the right drift (41°F) with a Raytek thermal gun were low enough to permit hibernation, suggesting this mine is not a commonly used hibernal site. Should closure be considered, the Sidney should be re-evaluated during summer as a result of the size and complexity of the mine.

Lookout Mountain Mine

Assessed for potential bat use in 1994, this mine was not traversed to the large stoped area until 27 October 1998. A few moth wings were seen. The back stope area was too extensive to be totally evaluated for bats, but no bats were observed along the back of the adit to this area and no bats were seen within visual sight with 500,000 cp white light illumination of the walls in the stoped area.

Thermal Assessment of Mines 1996-99.

International Mine

The International Mine consists of a single adit with five drifts. An inclined raise to the surface occurs approximately 350 feet from the portal. Four free-hanging thermal loggers were established in this mine (Fig. 3). Significant airflow was observed to occur between the portal and the inclined raise. Locations were selected to measure temperatures at the point of the raise (station 3), one station toward the long arm of the adit beyond the raise (station 4), one station approximately 260 feet from the portal, a position that was in full darkness, (station 1), and a station near the face of a drift off the main adit in the front portion of the mine (station 2). All loggers were placed approximately 6 inches from the mine back suspended by a piece of wire. The figures displaying the data, expressed as degrees Fahrenheit, collected at these stations are sequenced by site from the beginning of logging to termination. For conversion to centigrade, an alternate set are ordered in the same manner as Appendix C.

Site 1. (Figure 4a-e). Sequenced serial numbers: waterproof Optic StowAway 103435, 103433, 103434, 103461, range -05+137°C. Data from a moisture affected logger, #5111 (see Keller 1997a) have been included. Only March 1997 to July 1999 will be considered.

The winter temperature at this position for two winters consistent demonstrated a minimum of 38°F. The maximum temperature during the three summer periods logged demonstrate a maximum value of 56°F. The winter values suggest that full hibernation could, but did not occur at this location. The mean temperature in this portion of the mine ranges between 44-45°F and never dropped below freezing, in spite of the "chimney effect" that exists between the inclined raise (see ahead) and the portal.

Site 2. (Figure 5a-e). Sequenced serial numbers: 5144 StowAway range -5+37°C), plastic encased StowAway XTI 86762, range -19+122°C), and waterproof Optic StowAway 103435, 109813, 103439, range -05+137°C. The sequence runs from July 1996 to July 1999.

The winter temperature at this position for three winters was warmer than at site 1, ranging in low from 41.5 to 42.6°F. Hibernation in this area would be more "expensive" in fat loss. Summer maxima are cooler, ranging from 46 to 48°F. Thus, on average, this drift is 10 degrees cooler than where air flow is affecting station 1, an advantage for night roosting. I hypothesized that night-roosting bats may fly to this location. This prediction could be tested by light-tagging bats entering this mine. The mean temperature for each figure ranges from 44-45°F if the effect of the short period between sequential measurements for logger 5144 is excluded from consideration.

Site 3. (Figure 6a-c). Sequenced serial numbers: Waterproof Optic StowAway 103440, 103461, 103441, range -05+137°C. The sequence runs from August 1997 to July 1999.

The winter temperature at this position for two winters produced minimum temperatures that went below freezing (23.9 and 26.6°F) for short periods, a condition that would not permit hibernation in or below the

inclined raise during the entire winter, as bats would freeze. The maximum temperature during the two summer periods logged demonstrate a maximum value of 69-73°F degrees, a condition warmer than the other sites evaluated. The mean temperature averaged around 45°F. The data demonstrate an air flow pattern occurs through the inclined raise to the portal, that likely results from cold air "flowing" down the raise. Satisfactory hibernating conditions exist in November and March in the area below the raise, and perhaps within it. The data also suggest that the inclined raise should have been checked for hibernating bats near the surface until mid-winter, a procedure that unfortunately was not undertaken for safety reasons. In future research, evaluation of such raises or shafts, considered unsafe to enter, could be undertaken with a "Peeper" device attached to an extendable pole (Christensen Designs, Manteca, CA).

Site 4. (Figure 7a-c). Sequenced serial numbers: plastic encased StowAway XTI 86760, range -19+122°C, and waterproof Optic StowAway 109760, 118427, range -05+137°C. The sequence runs from August 1997 to June 1999.

The winter temperature at this position for two winters produced minimum temperatures that were consistently(44.8-44.9°F) too warm for hibernation. A consistent environment existed at this site for the period October through April both years. This pattern could permit species other than Townsend's bats to use this portion of the mine as a hibernal site, but none were ever found. The summer temperatures for the intervals available demonstrate maximum temperatures around 56°F, a condition that exceed those found at site 1. Again, the reason that site 1 is cooler results from the impact of airflow through the inclined raise to the portal. The mean temperature averaged around 46°F at site 4 of the mine. These data demonstrate that cold air does not impact site 4 significantly during winter and they do not demonstrate temperatures that would enhance hibernation. Consequently, the area beyond this point, which was sometimes not fully traversed during winter searches, could not be argued to be cold enough to support hibernating Townsend's bats. In summary, the configuration of the International mine demonstrates that additional openings into the mine greatly impact the thermal envelope available for use by bats. However, the configuration of the mine does not appear to permit the development of conditions similar to a cold air trap, a situation that produces the optimal thermal conditions needed to support hibernation by Townsend's big-eared bats.

Rock Creek Mine

Although the single adit of this mine is extremely long and dry in deeper portions, bats only appeared to use it during summers as a roost site. Two sets of thermal data considered adequate for analysis were provided by a plastic encased StowAway XTI 86759, range -19+122°C, and waterproof Optic StowAway 103441 range -05+137°C. The sequence, collected from September 1996 to July 1997 (Fig. 8a-b) was obtained 6 inches from the back of the mine approximately 270 feet from the portal. Temperature fluctuations at this site vary little seasonally or among years. They range within a degree of an average temperature of 45°F, a condition that likely contributes to the use of this mine for summer only. The second set of data developed were collected within 6 inches of the mine back at 525 feet from the portal (Fig. 9a-b). Waterproof optic StowAway temperature loggers 103436 and 109760 operated here from August 1997 to July 1999. This site also demonstrates less than one degree Fahrenheit drop in temperature during winter. Additionally, because the mean temperature near the back of this mine varies little seasonally, and the mean temperature in this mine is above the optimal temperature required for bats to hibernate, further winter searches for hibernating individuals would seem inappropriate. On the other hand, it would be of interest to learn why *Myotis californicus* use this mine. Acoustic feeding buzzes, observed when this species was collected by harp trap, suggests that it was feeding on insects accumulated inside the large wooden hood over the portal.

Big It Mine

The Big It Mine was studied from July 1997 to July 1998 as a result of the discovery of a single day-roosting bat and bat sign when it was traversed. Data collected at 550 feet from the portal and 6 inches from the back by waterproof Optic StowAway loggers 109820 and 103439 demonstrate almost no thermal variation around the mean temperature of 47°F (Fig. 10a-b). The few minor sudden spikes from this value may have been produced as a result of infrequent intrusion into the area under the loggers by the caretaker of this property rather than variation as a result of warm air intrusion. This mine appears to be without merit as a potential hibernal site for bats.

In summary for the thermal inventory, the hypothesis that the lack of winter hibernation in the Silver Valley results from thermal conditions that are not optimal is supported, but data are needed for other mines that either have multiple entrances or shafts that permit thermal gradients to develop similar to the gradients found in the International mine. Fortunately, the thermal envelope properties of mines containing overwintering bats, also required to test this hypothesis, is presently being gathered for mines in Boundary County that support Townsend's bats.

SUMMARY OF FINDINGS

1. Seventy-one sites have been reviewed as potential habitat for bats. Fifty sites were on BLM managed lands, 12 on patent claims, 7 on Forest Service lands, 1 on a privately held parcel, and 1 over water. In all, 24 open portals were located. Sixteen of the open portals were on BLM managed land. Fifteen of the 16 portals were either sampled directly by net or harp trap or were used for counts of day-roosting bats within the adit during summer and winter traverses.

2. Significant bat sign has only been evident at two mines in the Silver Valley, the Big It mine and the Constitution.

3. No bats have been found hibernating at any adits surveyed in the Silver Valley.

4. Only two instances of day roosting have been documented in the Silver Valley.

5. Night roosting (or feeding on insects in mine portals) was common to all mines netted. The number of individuals captured has been limited to fewer than ten at any site. The conditions impacting mine use remain unknown, but available habitat would not seem to be a limiting factor in the Silver Valley.

6. Capture rates are not improved by using harp trap capture over netting capture.

7. No specimens of Townsend's big-eared bat have been captured in the Silver Valley and no records exist that document this species historically occupied the area.

8. Captures in the Silver Valley have included: *Myotis californicus*, *M. evotis*, *M. lucifugus*, and *M. thysanodes* (1 only) and *M. yumanensis*. Three of these species are listed as sensitive by the BLM.

9. Thermal profiles have been developed for mines with one opening. The thermal envelope in mines with a single portal are consistent seasonally and appear to maintain temperatures that are not physiologically adequate for hibernation.

10. The thermal profile of one mine with an inclined raise to the surface and one portal demonstrates a thermal envelope that changes seasonally and differs within segments of the mine during summer. Research is needed to establish just how this thermal envelope is used during summer night roosting.

11. The Lookout Mountain and Sidney mines should be studied more thoroughly.

12. A study of the levels of heavy metals in bats in the Silver Valley may provide important information on why the density of bats appears to be limited in this geographical area of Idaho.

RECOMMENDATIONS

This report details a thermal and search/netting and harp trap assessment of selected inactive mines that could support bat populations in northern Idaho. Patchy concentrations of the insects on which bat species feed are likely important to night roost-site selection as are temperature suitability. Consequently, sites used may vary with seasonal factors that affect the prey base as well as the thermal envelope in mines. Although random netting in an area may provide adequate information on species composition if several mines are assessed, the decision to seal a single mine by explosive charge should never be completed based upon one assessment, a process that has been common in states that neighbor Idaho.

To improve the Conservation Strategies being developed for Idaho bats, extensive research is needed on bat use of abandoned mines coupled with a study of forest use by bat species in a manner similar to research recently completed on tree/snag/cavity use in Caribou National Forest (see Bohn 1999). The following recommendations pertain to the research completed in the Silver Valley and near Murray during the period 1994-99 only.

1. I strongly recommend that the **portal** of the International mine be closed with a bat-friendly gate that permits entrance for research. This is the only site investigated that I would gate for the following reasons: 1) a gate would not be difficult of construct as a result of the size of the opening and the location of the portal, 2) this mine is worthy of extensive analysis of bat use of the thermal envelope during summer, a task which could be accomplished by re-establishing and increasing the number of thermal logging stations gathering data. The cost of the scientific equipment placed inside to complete further studies necessitates protection against theft which will likely be prevented by a gate, 3) this mine can be used for a scientific analysis of *M. evotis* populations because it is located along an all-season accessible public road, and 4) this mine is far more dangerous to children living in this area than most of the other mines that have been reviewed to date.

2. I recommended that permanent **winter** sampling procedures be initiated for the International Mine on the basis of a cooperative agreement formed between Idaho Museum of Natural History and the Bureau of Land Management.

3. I strongly recommended that a formal memorandum of understanding be formed between the Forest Service and the Bureau of Land Management outlining process for completing biological inventories prior to any mine closures on land managed by either party in the Silver Valley.

4. I strongly recommend that further mines on BLM lands in the Murray area be investigated.

5. I strongly recommend that mines documented by Hustedde et al. (1981) for the Sandpoint Quadrangle be investigated.

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APPENDICES

APPENDIX A - Typical mine features and terminology
Figure 1

APPENDIX B - Exact position of mines surveyed 1994-99
Figures 1-10

APPENDIX C - Alternate thermal plots in degrees Centigrade for the International Mine, Rock Creek Mine, and the Big It Mine
Figures 1-22