

I. MINING IMPACTS

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Twenty-eight (62%) of the 45 bat species in the U.S. use mines (Altenbach and Pierson 1995). Bats have become dependent upon abandoned mines for roosting habitat where recreational caving and deforestation have diminished natural bat habitat (Tuttle and Taylor 1994; Altenbach and Pierson 1995). Colorado has an estimated 23,000 inactive mines and survey results indicate that about 50% of abandoned mines show signs of bat roosting habitat, and approximately 18% are characterized as important sites of bat activity (K. Navo, unpublished data). The abandoned mined lands (AML) program has led many agencies to inventory mine locations.



Ladder gate on mine. Photo by K. Navo.



Full gate on mine. Photo by K. Navo.

For instance the National Park Service (NPS) has identified 3,200 mine sites in the national park system, with 10,000 individual mine openings (Burghardt 2003). Like cave roosts, mines are used as hibernacula, maternity roosts, bachelor colonies, transitional roosts, migratory stopovers, night roosts, or drinking sites. Yet unlike caves, abandoned mines are being systematically closed for public safety. This activity can pose a threat to bats that use mines, and mine closure methods can be destructive to bat roosts if done at an improper time (Altenbach and Pierson 1995). However, gates that keep out humans but allow access by bats have been used extensively in the eastern US for over 40 years. To preserve critical habitat, bat gates must be designed to allow unrestricted ingress and egress, especially for maternity roosts. The bat gate closure must also minimize changes to the microclimate of the roost (Tuttle 1977; White and Seginak 1987; Richter et al. 1993).

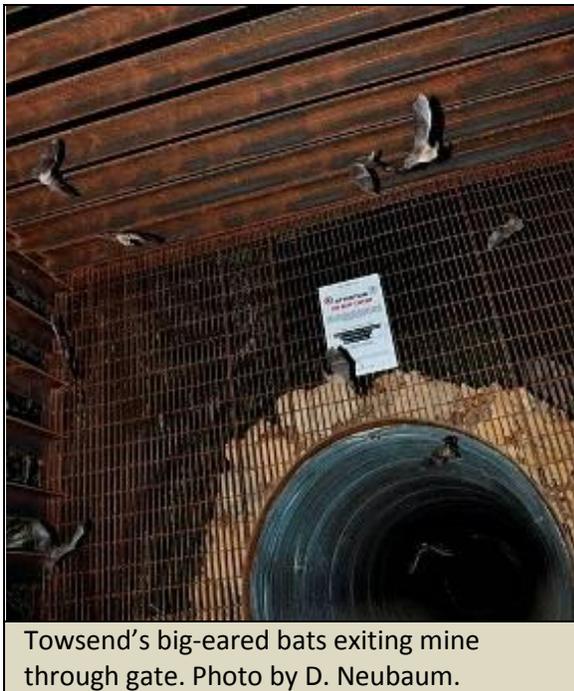
Since 1980, government agencies, conservation groups, and private individuals have safeguarded over 6,120 abandoned mines in Colorado and many thousands more in the US. In 1990 the Colorado Division of Wildlife (now Colorado Parks and Wildlife; CPW) and the Colorado Division of Minerals and Geology (now Division of Reclamation, Mining, and Safety; DRMS) began a cooperative effort — the Bats/Inactive Mines Project — to survey all abandoned mine openings for bat use prior to closure, and to install bat gates on those openings that provide critical habitat. In 2013, a trend towards moving



Culvert ladder gate. Photo by K. Navo.

away from bat surveys at mines in AML programs was initiated, and replaced with an approach to gate all mines with potential for providing bat habitat. As of 2013, DRMS, CPW, Bureau of Land Management (BLM), and U.S. Forest Service (USFS) have installed more than 850 bat-compatible closures on inactive mines. Some mines have multiple openings and require more than one gate. While more research is needed on species-specific responses to particular cave/mine gate designs, results of over 20 years of post-gate evaluations indicate several designs are working well (Navo and Krabacher 2005).

Mines are used as habitat by 14 Colorado bat species, including some identified in CPW's State Wildlife Action Plan (SWAP) as Tier 1 Species of Greatest Conservation Need (Townsend's big-eared bat; *Corynorhinus townsendii*), little brown bat (*Myotis lucifugus*), fringed myotis (*M. thysanodes*), and other species, some of which were formerly designated as Category 2 candidate species under the Endangered Species Act (ESA; USFWS 1994). The following bat species are known to use mines as day roosts,



maternity roosts, transition roosts or hibernacula: Townsend's big-eared bat, California myotis (*M. californicus*), western small-footed myotis (*M. ciliolabrum*), long-eared myotis (*M. evotis*), little brown myotis, fringed myotis, long-legged myotis (*M. volans*), pallid bat (*Antrozous pallidus*), big brown bat (*Eptesicus fuscus*), and Yuma myotis (*M. yumanensis*). In addition, a unique bachelor colony of 100,000 to 250,000 Brazilian free-tailed bats (*Tadarida brasiliensis*) inhabits the Orient Mine in the San Luis Valley during the summer. This is the largest known bat colony in Colorado.

Abandoned mines are particularly important to Townsend's big-eared bats, a Colorado Species of Special Concern, a Tier 1 Species of Greatest Conservation Need in the SWAP, a former category 2 candidate under the ESA (USFWS 1994), a Sensitive Species for the USFS, and a Special Status Species for

the BLM. The author knows of 18 Townsend's big-eared bat maternity roosts in Colorado, 15 of which are in abandoned mines. There are hundreds of hibernacula and/or transient roosts currently known, most of which are in abandoned mines. Most of these colonies are small in size and estimated to contain fewer than 30 individuals per mine. Identification and preservation of mines for bat habitat is critical to maintaining current populations of Townsend's big-eared bats and other sensitive bat species. Bat gates prevent unwanted human access to dangerous mines while preserving critical bat habitat.

Another factor that could impact mine-roosting bat species in Colorado is active mining operations. Renewed mining activity at previously inactive mines can disrupt or destroy habitats. Construction of associated facilities, road development, and deforestation can potentially impact drinking and foraging

habitat, particularly at surface mines and ore processing sites. Cyanide leach ponds that do not restrict bat access are of particular concern as they may attract bats and birds. Surveys have shown that bats are among the most numerous mammals found dead of cyanide poisoning at these water sources (Clark 1991; Clark and Hothem 1991). Currently, there are no open cyanide ponds in Colorado and there are existing policies to ensure that there is no overall net loss of critical or important wildlife habitat consistent with CPW and USFWS recommendations. Critical habitat is often excluded from a mining permit area, or poor habitat is upgraded to compensate for the loss of habitat from mining operations. In cases where “renewed mining” is occurring, current rules and regulations consider “pre-existing conditions and the degree to which the proposed plan would provide for net improvements in the protection of human health, property, or the environment (Mineral Rules And Regulations Of The Colorado Mined Land Reclamation Board For Hard Rock, Metal And Designated Mining Operations, 2 CCR 407-1, Rule 6.4.20 (18)). For cyanide ponds, active mine operations are required to net or otherwise restrict access by birds and bats to ponds that contain more than 40 ppm cyanide. Active mines are also regulated to prevent releases of acid mine drainage, from surface or groundwater, that do not meet water quality standards. In the permit application, mining companies are required to “describe measures to prevent wildlife from coming into contact with designated chemicals, toxic or acid forming chemicals, or areas with acid mine drainage (Mineral Rules And Regulations Of The Colorado Mined Land Reclamation Board For Hard Rock, Metal And Designated Mining Operations, 2 CCR 407-1, Rule 6.4.20 (18)).

Over the last 20 years, the issue of renewed mining activity at inactive mines has become a concern for bat conservation (e.g., the recent resurgence in uranium mining in the state). The rise in value of some minerals provides increased interest in mining, and inactive mines often provide locations of interest to the mining industry. Previously gated mines for bats are also being claimed and re-opened for mining activity, thus impacting existing bat colonies and removing protected habitat for some species of bats. While mining laws allow for such activities, it is important for resource managers to provide input that encourages exclusion of bats prior to renewed activity, and/or consideration of delaying initiation of mining activity until the season of bat use is past. It is also important for resource managers within AML and wildlife programs to maintain good communications during the mine permitting process, so that mines with bat gates or those known to be important bat roosts, are identified early in the process, and provide opportunities to avoid or minimize impacts to the bats utilizing such features.

A new issue for bats and mines is the emerging disease White-nose Syndrome (WNS). This disease has caused the death of millions of bats in the Eastern U.S. and Canada (USFWS 2012), and WNS has been moving westward since its discovery in 2007. This will affect issues such as surveying at abandoned mines, recreational caving and potential of human transmission of the disease, and elevate the need to monitor for the potential arrival of WNS to Colorado. See chapter VII. Bats and Disease for goals and objectives related to this issue.

Survey techniques and protocols are continually being revised to accommodate new research into bat dependence on mines. The advancement of infrared video equipment, acoustic monitoring equipment

and techniques, and data loggers to gain insights into roost microclimate have provided more effective means of surveying and collecting important data needed in bat conservation efforts. Since mines are inherently dangerous, it is imperative that this research be conducted in a safe manner. Oxygen-deficient air, toxic gases, unstable rock, and vertical drops in and around abandoned and inactive mines have claimed 18 lives and injured 23 people in Colorado since 1955. For further discussion of potential hazards and the safety procedures to be followed at abandoned and inactive mine sites see Altenbach (1995), Burghardt (1996, 1997, 2002), Navo (2001), and Sherwin et al. (2009).

We address three categories of issues for mine-roosting bats in Colorado: inadequate knowledge of bat dependence on mines; renewed and active mining practices; and closure of abandoned/inactive mines.

INADEQUATE KNOWLEDGE OF BAT DEPENDENCE ON MINES

To conserve bat populations, it is essential to determine the importance of mines to bats. This includes determining bat dependence on mines, mine structure, configurations that provide ideal habitat, and population trends of species that utilize mines for roosts.

GOAL

IDENTIFY AND DETERMINE THE IMPORTANCE OF MINES AS ROOSTING HABITAT.

Objective 1: Continue to advance our knowledge on critical microclimate factors that limit bat populations inhabiting mines, particularly for species of concern, to help identify and protect roosting habitat.

Objective 2: Continue the development and evaluation of new research techniques for identification and monitoring of bat species that inhabit mines, and for the evaluation of mines as roosting habitat.

Objective 3: Research the significance of abandoned mines as roosting habitat to population viability of various species of bats, especially Townsend's big-eared bats.

MANAGEMENT RECOMMENDATIONS

- Establish or support a long term monitoring program to document population numbers and trends for species that inhabit protected mines, particularly species of concern.

RESEARCH NEEDS

- Continue the development of non-intrusive monitoring techniques and equipment for use at abandoned mines.
- Continue to delineate the microclimate requirements of mine-roosting bats, and application to the issue of WNS.
- Develop techniques to monitor population trends of mine-roosting bats (see also section XI. Species Status, Population Trends, and Monitoring).

- Develop research projects to evaluate the use of non-mine/cave subterranean habitat of Townsend's big-eared bat.

RENEWED AND ACTIVE MINING PRACTICES

Renewed mining activity at inactive mines has the potential to impact existing bat colonies, and destroy protected/gated mines as bat roosts. This type of mining activity can disrupt on-going bat conservation efforts, and cause the loss of important bat roosts. Additionally, active mining operations have the potential to impact bat populations (Brown 1997) and their habitats. The Mining Rules governing the permitting and operation of active mines are promulgated by the multidisciplinary Mined Land Reclamation Board and administered by the DRMS and other regulatory agencies. The rules prevent harm or damage to wildlife species or habitat. However, as research on bats continues, new information should be disseminated to regulatory agencies and mining operations in order to develop reclamation techniques that preserve bat populations.

GOAL

PRESERVE FORAGING AND CRITICAL NON-MINE HABITATS, AND MINIMIZE IMPACTS TO EXISTING BAT COLONIES IN ACTIVE MINE AREAS.

Objective 1: Provide information and technical support to mine operators and regulatory personnel about sensitive bat species, bat conservation practices, and mechanisms to preserve habitat.

Objective 2: Provide information and technical support to mine operators and regulatory personnel to monitor the success of bat conservation measures.

Objective 3: Promote proper exclusion of bats from mines that are slated for renewed mining. Encourage the delay of mining activities until the season of bat use is finished, if exclusion is not possible.

Objective 4: Work with mining companies to identify and implement new artificial bat habitats.

Objective 5: Consider options, such as formal mine withdrawals from mining claims, of significant bat roosts (See Neubaum et al. 2017) at currently inactive mines to provide long term protection and conservation.

MANAGEMENT RECOMMENDATIONS

- Continue to work with mining companies and regulatory agencies to implement techniques that minimize and mitigate mine-related impacts.
- Promote effective communication between land use agencies, resource managers, and mining interests to minimize impacts to bat roosts at mines under consideration for renewed mining activity.

- Promote proper bat exclusion techniques and timing at mines with bat use prior to closures or renewed mining activities.

RESEARCH NEEDS

- Continue studies of mine design and reclamation techniques that enhance bat habitat at the conclusion of mining operations. This should include the development of viable bat roosts.
- Determine the nature and extent of water quality problems and their effects on bat populations.
- Determine the impact of active mining operations on bat populations.

CLOSURE OF ABANDONED/INACTIVE MINES

Closure of abandoned mines for public safety can eliminate important bat habitat. Resource managers can contact the following agencies/organizations and corresponding project managers for further information regarding AML programs and activities: CPW, Colorado Natural Heritage Program, Colorado Division of Reclamation, Mining, and Safety.

GOAL

PRESERVE CRITICAL HABITAT IN ABANDONED MINES TO PROTECT VIABLE BAT POPULATIONS, ESPECIALLY SPECIES OF CONCERN.

Objective 1: Promote and implement safe and effective protocols for surveying abandoned mines (e.g., Altenbach 1995; Navo 2001; Sherwin et al. 2009).

Objective 2: Survey all abandoned mine openings slated for closure to identify critical bat habitat and increase our knowledge of bat distribution, roosting ecology, and species status. This is especially important in light of the potential arrival of WNS to the state.

Objective 3: Implement WNS decontamination protocols for all surveys and reclamation activities at abandoned mines.

Objective 4: Promote and implement protocols for installing bat-compatible closures (e.g., Dalton and Dalton 1995; Tuttle and Taylor 1998; Navo and Krabacher 2002; Burghardt 2003). Evaluate any modifications to accepted bat gate designs before widespread implementation.

Objective 5: Exclude bats from mines that are slated for closure when gating is not feasible. Promote proper exclusion techniques and timing to AML programs and personnel.

Objective 6: Continue to evaluate the success of bat gates and any design modifications by monitoring mines before and after gate installation to determine post-gate usage, colony numbers and trends, and effects on mine microclimate from gate designs (Navo and Krabacher 2005).

MANAGEMENT RECOMMENDATIONS

- Work with DRMS and federal agencies to install bat-compatible closures on mines that are important bat habitat, particularly for species of concern (see Neubaum et al. 2017). Ensure that proper bat exclusion techniques are used prior to mine closures when not bat-compatible.
- Promote bat surveys at mines scheduled for closures in state and federal AML programs, to ensure collection of valuable information on bat populations and WNS monitoring. Information obtained by surveys, such as species presence, microclimate data and roost types, provides important data for managers to gain support for conservation actions and species status monitoring.

RESEARCH NEEDS

- Determine the roosting habits of bats that use abandoned mines and identify the types of non-mine roosts that are used by these species. Documentation is especially important for Townsend's big-eared bat and other species of concern, and is necessary to help determine the importance of mines as available roosting habitat (see Considerations for Bat Roost Protection).
- Determine the success of bat gate designs used in Colorado, and research potential modifications to enhance their success for bat conservation and public safety (Ludlow and Gore 2000).
- Determine short- and long-term potential impacts of radioactive exposure on bat populations inhabiting uranium mines, particularly species of concern, and the importance of these mines to bat populations.
- Research the importance of mine clusters to local colonies and the impacts to these colonies of closing a portion of a cluster. This would include studies on the movements between nearby roosts by various species of bats.

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