

**THE NORTH AMERICAN BATS AND MINES PROJECT:
A COOPERATIVE APPROACH FOR INTEGRATING BAT CONSERVATION
AND MINE-LAND RECLAMATION**

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ABSTRACT

Inactive underground mines now provide essential habitat for over half of North America's 45 bat species. However, thousands of abandoned mines have already been closed or are slated for safety closures, and many are destroyed during renewed mining. The available evidence suggests that millions of bats have already been lost due to these closures. Bats are primary predators of insects that cost farmers and foresters billions of dollars annually, therefore, threats to bat survival are cause for serious concern. Fortunately, mine closure methods exist that protect both bats and humans. Bat Conservation International and the USDI-Bureau of Land Management founded the North American Bats and Mines Project to provide leadership and coordination to minimize mine-roosting bats losses. This partnership involves federal, state, and local officials and the mining industry. BCI has trained hundreds of managers in bat/mine assessment techniques and bat-compatible closure methods, published technical bat/mine information, presented papers at national mining and wildlife conferences, and collaborated with numerous government and private partners to protect the most important mine-roosting bat populations. Our new initiative, Mining for Habitat, helps mining companies and private landowners develop bat habitat conservation and enhancement plans including bat education, surveys, mitigation, and even artificial roost creation.

INTRODUCTION

Bats are one of the most important, yet least understood groups of animals in the world. Across North America, bats play a vital role in both natural and managed ecosystems. Bats are key predators of night-flying insects that cost farmers and foresters billions of dollars annually, and they are pollinators of several keystone desert plants in the American Southwest and Mexico. Despite their importance, bats are often persecuted both intentionally and unintentionally, and they continue to decline from habitat loss, environmental toxins, and disturbance at key roost sites. Bats currently represent the most imperiled order of land mammals in the United States and Canada.

Due to disturbance of bats' traditional roosts in caves and tree hollows, abandoned and inactive underground mines have now become refuges of last resort for more than half of the 45 bat species found in the United States and Canada, including some of the largest remaining populations. As thousands of abandoned mines are being reclaimed, available evidence suggests that millions of bats have been inadvertently buried or have

lost crucial habitats. Closure of abandoned mines without first evaluating their importance to bats is perhaps the single greatest threat to many North American bat populations. Bat Conservation International (BCI) and the United States Bureau of Land Management (BLM) founded the North American Bats and Mines Project (NABMP) in 1993 to address conservation issues facing mine-roosting bats. The NABMP provides national leadership and coordination among federal, state, and private agencies and the mining industry to minimize the loss of mine-roosting bats. The NABMP has four primary objectives: to educate natural resource managers and the public on the importance of mines for bats; to train wildlife and mine-land managers on mine assessment and closure methods that protect both bats and people; to assist agencies and industry in protecting and enhancing bat roosts in abandoned mines; and to develop techniques to create new bat habitats during mine-land reclamation on federal and private lands.

THE IMPORTANCE OF MINES TO BATS

Although caves are numerous in some regions, most are now too frequently disturbed by humans to permit bat use. In addition, bat populations have lost countless traditional roosts in old tree hollows due to logging. Over the past 100 or more years, displaced bats have gradually moved into abandoned mines, which often provide microclimates similar to caves. In regions where natural caves do not occur, mines represent new "super habitats" that have concentrated colonial bat populations formerly distributed in smaller numbers across the landscape (Brown and Berry 1991).

Mines are key to the life history of bats and are critical for many purposes such as rearing young in the summer, winter hibernation, gathering for social activities (such as courtship and mating), and night roosting (places where bats temporarily rest to digest their prey between foraging bouts). Mines also serve as crucial rest stops between spring and fall migration. Abandoned mines are often the only suitable shelters left midway between bat summer and winter roosts. Without these protected resting places, migratory mortality could increase tremendously. Although mines are utilized for many reasons, their use as bat maternity and hibernation sites is essential to the survival of several North American species. The microclimate, most importantly the temperature, determines whether bats will use a particular mine. Warm sites are selected for maternity roosts, while cold sites are chosen for hibernation.

Bats that roost in smaller groups typically require temperatures between 70 and 90°F (for maternity use). Big-eared bat (*Corynorhinus* spp.) maternity roosts have sometimes been recorded in colder sites where ambient temperatures are as low as 60°F. Approximately one-quarter of the bat species in the United States

and Canada are believed to hibernate almost exclusively in old mines or caves (Turtle and Taylor 1998). Suitable hibernation sites for bats in all regions must protect bats from freezing, and for most species, should provide stable temperatures throughout the winter above the freezing point but below 50°F. Some desert dwelling bats may be an exception and often hibernate in mines with temperatures below 58°F (Brown, pers. com. 1997).

While any abandoned mine may be important to bats, the larger, more complex and dangerous mines, with multiple entrances, often harbor the most significant populations. This is because large and complex mines offer bats a measure of security no longer found in caves. The complexity and associated airflow of these mines provides a range of internal temperatures suitable for bats (Altenbach 1995). These complex sites are most often found on private mining industry lands.

Of the more than 8,000 mines surveyed by researchers in Arizona, California, Colorado, New Mexico, Oregon, and Washington, approximately 45 to 75 percent showed signs of use by bats, with an average of 10 percent containing important bat colonies. From the Great Lakes Region north and eastward in the United States and Canada, up to 70 percent of open, unflooded subsurface mines having sufficient volume to protect bats from freezing, may be used by hibernating bat populations.

ABANDONED MINE CLOSURES: EFFECTS ON BATS

In the last decade alone, thousands of abandoned mines have been permanently closed by backfilling, capping, blasting, or other methods, and until recently few were first evaluated for their importance to bats. Available evidence suggests that millions of bats have already been lost, or their roosts destroyed. Bats now have few alternatives to abandoned mines, and are so instinctively committed to certain sites that they often cannot change roosts in the time allowed by current rates of mine closure (Altenbach, pers. com. 1996). Due to their colonial nature, many bat species are especially vulnerable to mine closures, and hundreds-of-thousands of bats can be lost in a single closure.

In the western United States, Townsend's big-eared bats (*Corynorhinus townsendii*) are particularly dependent on abandoned mines (Altenbach 1995). The largest known populations, numbering up to 10,000, have been found in deep, complex workings, however, even shallow or simple workings will often be used by small groups of up to several hundred. Endangered Indiana bats (*Myotis sodalis*) and southwestern cave myotis (*M. velifer brevis*) have been found in mines in numbers approaching 100,000. Similarly, the largest

known hibernating populations of the southeastern big-eared bat (*Corynorhinus rafinesquii*), a United States candidate for the endangered species list, live in abandoned iron and copper mines in small groups ranging from a few dozen to more than 500. Table 1 provides a list of North American bats known to use mines (Tuttle and Taylor 1998).

Little brown bats (*Myotis lucifugus*) are among North America's most abundant bat species. However, in the northern United States and Canada, these bats rely almost exclusively upon abandoned mines for hibernation sites. If a mine is closed during winter months (trapping the bats inside) a multi-state region can be affected. This is due to the fact that little brown bats travel from summer colonies thousands; of miles away to hibernate in mines. Closure of mines without first checking for bats could drastically reduce bat numbers, needlessly endangering many species.

Many examples underscore the magnitude of potential bat losses from abandoned mine closures. More than 50,000 little brown bats were temporarily entombed in a western Wisconsin mine closure' before biologists were able to have the mine reopened. The old Neda Mine in Iron Ridge, Wisconsin, was threatened with closure before being acquired by a local University. It is now home to nearly half a million little brown bats, as well as large populations of big brown bats (*Eptesicus fuscus*), eastern pipistrelles (*Pipisirellus subflavus*), and northern long-eared myotis (*Myotis septentrionalis*).

In December 1992, an estimated three quarters of a million little and big brown bats were found in the Millie Hill Mine in Iron Mountain, Michigan. It was slated to be backfilled the following spring. Instead, BCI convinced the town to close the mine with a large steel cage, protecting the bats and human safety (Tuttle and Taylor 1998). These bats comprise the second largest hibernating bat population ever discovered in North America. A local mine inspector from Iron Mountain, Michigan, reported that of the 12 mines closed prior to 1993, some contained significantly large bat populations, perhaps even more than were saved in the Millie Hill Mine.

THE ROLE OF BATS IN ECOSYSTEM MANAGEMENT

Bats are primary predators of vast numbers of insects that fly at night, and many such insects rank among North America's most costly agricultural and forest pests. Just a partial list of the insects these bats consume includes cucumber, potato, and snout beetles; corn-borer, corn earworm, cutworm, and grain moths;

Table 1. North American bats that use mines for maternity and/or hibernation sites.

| Species | Colony Sizes | Range | Use Time |
|-------------------------------------------------------------|-------------------------------|----------------------|-----------------|
| Ghost-faced bat <i>Mormoops megalophylla</i> | Dozens to hundreds | AZ & TX | Year-round |
| California leaf-nosed bat <i>Macrotus californicus</i> | Dozens to over a thousand | AZ, southern CA & NV | Year-round |
| Mexican long-tongued bat <i>Choeronycteris mexicana</i> | A dozen or fewer | AZ, southern CA & NM | Summer |
| Lesser long-nosed bat <i>Leptonycteris curasoae</i> * | Hundreds to thousands | AZ & NM | Summer |
| Greater long-nosed bat <i>Leptonycteris nivalis</i> * | Hundreds to thousands | TX & NM | Summer |
| Southeastern myotis <i>Myotis austroriparius</i> | Hundreds to thousands | Southeastern U.S. | Year-round |
| California myotis <i>Myotis californicus</i> | Up to a hundred | Western U.S. | Year-round |
| Western small-footed myotis, <i>Myotis ciliolabrum</i> | Up to hundreds | Western U.S. | Year-round |
| Long-eared myotis <i>Myotis evotis</i> | Dozens | Western U.S. | Year-round |
| Gray bat <i>Myotis grisescens</i> * | Hundreds to 50,000 or more | Southeastern U.S. | Year-round |
| Small-footed myotis <i>Myotis leibii</i> | Dozens | Eastern U.S. | Winter |
| Little brown bat <i>Myotis lucifugus lucifugus</i> | Hundreds to a million or more | Northern U.S. | Year-round |
| Arizona myotis <i>M. l. occultus</i> | Hundreds | Southwestern U.S. | Year-round |
| Northern long-eared myotis <i>Myotis septentrionalis</i> | Hundreds to thousands | Eastern U.S. | Winter |
| Indiana bat <i>Myotis sodalis</i> * | Hundreds to 100,000 or more | Eastern U.S. | Winter |

Table 1. (Cont.) North American bats that use mines for maternity and/or hibernation sites.

| Species | Colony Sizes | Range | Use Time |
|---------------------------------------------------------------|--------------------------------|-------------------------------------|-----------------------------------|
| Fringed myotis <i>Myotis thysanodes</i> | Dozens to hundreds | Western U.S. | Year-round |
| Cave myotis <i>Myotis velifer</i> | Hundreds to 100,000 or more | Southwestern U.S. | Year-round |
| Long-legged myotis <i>Myotis volans</i> | Hundreds | Western U.S. | Year-round |
| Yuma myotis <i>Myotis yumanensis</i> | Hundreds to thousands | Western U.S. | Year-round |
| Western pipistrelle <i>Pipistrellus hesperus</i> | Dozens | Western U.S. | Year-round |
| Eastern pipistrelle <i>Pipistrellus subflavus</i> | Dozens to thousands | Eastern U.S. | Winter |
| Big brown bat <i>Eptesicus fuscus</i> | Dozens to hundreds | North America | Year-round |
| Allen's lappet-browed bat <i>Idionycteris phyllotis</i> | Dozens to about two hundred | Mostly AZ, also parts of NV & CO | Year-round |
| Southeastern big-eared bat <i>Corynorhinus rafinesquii</i> | Dozens to several hundred | Southeastern U.S. | Year-round |
| Pacific big-eared bat <i>C. townsendii townsendii</i> | Dozens to hundreds | Western U.S. | Year-round |
| Ozark big-eared bat <i>C. t. ingens</i> * | Dozens to hundreds | Ozark Mountains | Year-round |
| Western big-eared bat <i>C. t. pallescens</i> | Dozens to thousands | Western U.S. | Year-round |
| Virginia big-eared bat <i>C. t. virginianus</i> * | Dozens to thousands | KY, VA & WV | Year-round |
| Pallid bat <i>Antrozous pallidus</i> | Dozens to hundreds | Western U.S. | Year-round |
| Mexican free-tailed bat <i>Tadarida brasiliensis</i> | Hundreds of thousands | Southwestern U.S., north to OR | Mainly summer, some year-round |

* Endangered

leafhoppers; and mosquitoes. Just one of the little brown bats that hibernate in Michigan's Millie Hill Mine can catch 1,200 mosquito-sized insects in an hour. A colony of Mexican free-tailed bats (*Tadarida brasiliensis*) living in the old Orient Mine in Colorado consumes nearly two tons of insects nightly, mostly moths. The larva of one of these, the cotton bollworm moth (*Helicoverpa zed*), attacks a wide variety of crops including corn, cotton, tomatoes, and pumpkins. Since each female cotton bollworm moth can lay thousands of eggs, as few as 100 moths can force a farmer to spray hundreds of acres of crops with pesticides. Recent research in Indiana has shown that just 150 big brown bats can eat sufficient cucumber beetles each summer to protect farmers from 33 million of these beetles' root worm larvae, pests that cost farmers an estimated billion dollars annually (Wriittaker 1995).

In the United States long-nosed (*Leptonycteris curasoae* and *L. nivalis*) and long-tongued (*Choeronycteris mexicana*) bats are important pollinators for some 60 species of agave plants, and they serve as both pollinators and seed dispersers for dozens of columnar cacti species including organ pipe and saguaro. These cacti rank among the southwestern desert's most familiar and ecologically important plants (Howell 1980). Many wildlife species depend on these plants for food and shelter. The loss of bat pollinators could further jeopardize these already declining plant populations, damaging an entire ecosystem. When ecosystems are modified for natural resource production such as timber, minerals, or agriculture, maintaining habitat for bats will not only ensure the survival of these important wildlife species, but will also benefit the sustainable production of natural resource products.

THE NORTH AMERICAN BATS AND MINES PROJECT

The NABMP is a partnership between BCI and the BLM created to address the plight of mine-roosting bats. BCI is a world leader in bat conservation initiatives, and the BLM manages some 270 million acres of public lands, which contain a large proportion of North America's abandoned mines. The Forest Service, Natural Resources Conservation Service, Fish and Wildlife Service, National Park Service, Office of Surface Mining, and many state agencies are also participating in the project. Mining companies, such as Homestake, BHP, Echo Bay, and Phelps Dodge, have been the newest addition to collaborative bat conservation efforts through our new Mining for Habitat initiative.

The purpose of the NABMP is to eliminate the loss of bats during abandoned mine-land reclamation, while still protecting human safety. By establishing and achieving the following NABMP goals, BCI and its agency partners will ensure that bat conservation measures are incorporated into the planning and operating procedures of agencies and organizations responsible for mine-land management and wildlife conservation.

Goal 1: Awareness, Education, and Training

Due to the NABMP, great progress has been made in raising awareness among key governmental agencies, private industry, and the public about the tremendous impact of mine closures on bats. BCI has developed an interpretive display booth on the bats and mines issue, which is being exhibited at key wildlife and mining conferences across North America. The display, along with technical paper presentations, is exposing thousands of mine-land and wildlife managers to the bats and mines issue. Dozens of articles on the NABMP have appeared in local and national newspapers, popular and trade magazines, Internet information services, and professional journals, including North America's largest mining and wildlife trade publications and journals, that reach additional thousands of land managers.

Training in mine assessment for bats is essential to ensure that wildlife and mine-land managers have the knowledge and skills necessary to identify, prioritize, and protect key bat roost sites. In December of 1994, BCI and its agency partners produced the *Bats and Mines* Resource Publication, which was revised and reprinted in 1998. This informative document summarizes the current knowledge of bat/mine habitat relationships, mine assessment and inventory techniques, and bat-compatible mine closure methods. *Bats and Mines* has been distributed to all major federal agencies responsible for bat conservation and mine reclamation, and is having a tremendous impact on resolving the bats and mines crisis.

Since the fall of 1993, BCI, the BLM, the Forest Service, other state and private partners, and the mining industry have collaborated to host 16 Mine Assessment for Bats workshops in Arizona, California, Idaho, Illinois, Michigan, Montana, New Mexico, Nevada, Ontario, Oregon, Virginia, and Wyoming. These three-day workshops have trained over 700 mine-land and wildlife managers from more than 70 agencies and organizations in mine assessment and protection techniques for bats.

Goal 2: Conservation Action

BCI is frequently contacted by agencies, organizations, and individuals across North America requesting financial and technical assistance to protect important mine-roosting bat populations. BCI has provided assistance to dozens of natural resource managers nationwide, protecting more than a million bats at some of the largest and most important abandoned mine bat roosts in the states of Arizona, California, Colorado, Idaho, Illinois, Michigan, Minnesota, New Jersey, New York, Oregon, Pennsylvania, Wisconsin, and the province of Ontario.

Goal 3: Interagency Coordination and Legislation

BCI is fostering cooperation and communication between government agencies, private organizations, and industry to ensure that wildlife and mine-land managers have the best and most current information available on mine assessment and closure techniques for bats, thereby increasing the efficiency of bat conservation efforts. BCI continues to initiate cooperative agreements with federal, state, and private agencies and industries that promote cooperation and partnership. Already, cooperative agreements have been developed with the United States government agencies: *BLM*, Forest Service, Natural Resources Conservation Service, Fish and Wildlife Service, National Park Service, and Office of Surface Mining.

Mine closure programs and policies, regulated by both federal and state law, can have profound effects on bat conservation. BCI plans to begin a status review of all existing and proposed state and federal abandoned mine reclamation legislation to determine the extent to which bat conservation needs are addressed. When necessary and appropriate, BCI will develop and propose suitable bat conservation language for incorporation in local, state, and federal mine reclamation legislation.

Goal 4: Research and Monitoring

BCI is supporting and conducting research and monitoring with direct implications for improving bat conservation and abandoned mine-land management. Research in bat conservation is essential for providing natural resource managers the most current information available upon which to base critical management decisions. Monitoring will ensure the effectiveness of future bat conservation measures.

BCI is currently involved in several monitoring projects such as mapping sensitive mine-roosting bat species ranges, recording effectiveness and species-specific acceptance rates of bat-compatible gates, especially during the critical maternity season. Data on specific habitat characteristics selected by bats at mine-roost sites, such as temperature, humidity, and air flow, is also needed. This data is being collected at several mines throughout the United States and Canada. This information will also be important in future artificial bat roost construction projects.

MINING FOR HABITAT

Because many of the largest and most important mine-roosting bat populations are located on private mining industry lands, BCI recently initiated an innovative partnership program, entitled "Mining for Habitat." This partnership program is designed to help mining companies enhance and conserve bats and bat habitat during

active mining and mine-land reclamation. BCI is working with industry partners to develop bat conservation and management plans for individual mine sites. Potential projects may include installing bat-gate mine closures to protect existing and potential underground mine roosts, providing bat-compatible wildlife water sources, and even creating cost-effective artificial underground bat roosts during active mining and reclamation. Because BCI is a nonprofit organization, cooperating companies benefit through tax deductible cost-sharing and other contributions.

Response to "Mining for Habitat" has been excellent. Many mining companies have joined to protect important bat species and have received outstanding coverage in major industry journals and professional publications, such as *Pay Dirt*, *Mining World News*, *The Mining Journal*, *Mining Engineering*, *Mining Voice*, *Randol International's Mining Opportunity Bulletin*, and *North American Mining*, as well as several national and local newspapers and magazines including *The Chicago Tribune*, *Popular Science*, and *National Geographic*. The following examples highlight some current achievements.

In 1996 the Unimin Corporation collaborated with BCI and the Forest Service to gate one of their recently inactivated silica mines in southern Illinois. This site had become an important fall and winter roost for approximately 3,000 bats including endangered Indiana bats, little brown bats, and northern long-eared myotis. Since the mine was protected, bat numbers, including those of the endangered! Indiana bat, are increasing. Indiana bats now account for 74% of the population (9,074 out of 12,293 bats). Thanks to our protection efforts, this mine now shelters the largest population of hibernating Indiana bats in Illinois. This is an excellent example of how the mining industry is actually creating and protecting habitat for an endangered bat species.

The Nevada Mining Association, and their member companies Barrick Gold, BHP, Placer Dome, and Newmont, joined forces with BCI and the BLM's Ely District to complete a restoration project that protected 70,000 Mexican free-tailed bats at Nevada's largest bat roost, the Rose Guano Cave and historic guano mine. The mine tunnel driven into the bats' roosting chamber to mine guano in the 1920s was blocked with a steel grate and removable steel plates to prevent disturbance to roosting bats and restore the cave to its pre-mining conditions.

After attending one of BCF's Mine Assessment for Bats workshops and learning how important mines are as bat habitat, managers from BHP Copper, Phelps Dodge, and Homestake Mining Company contacted BCI for assistance surveying more than 550 old mine workings for bats on their properties in Arizona and

Nevada. Surveys revealed that 10 to 15 percent of the abandoned mines have important bat colonies and excellent bat habitat. These old workings were slated for closure within weeks but these mining companies agreed to protect the mines, and many have already installed several bat-compatible steel gates. The abandoned mines not suitable as bat habitat are being backfilled. BCI even hosted a "bat education nights" at these mines. More than 200 people have attended, including mine employees, their families, and other members of the local communities interested in learning about bats and the proactive accomplishments of the mining companies.

The first industry-sponsored Mine Assessment for Bats workshop was held in August 1996, in Ontario, hosted by the Inco and Falconbridge Mining Companies and the Ontario Ministry of Mines. Taught by BCI biologists and leading bat experts, the workshop was attended by more than 30 mine-land managers from eastern Canada. This workshop is expected to have far-reaching impacts in maintaining Canada's largest remaining bat populations on private industry lands. Inco Mining Company has already committed to protecting critical bat habitats at their mine sites.

In perhaps the most exciting development of the Mining for Habitat Program, BCI is working with mining companies to create new underground bat habitat using on-hand mining materials buried during active mining and reclamation. Most mines have surplus mine-truck tires, culverts, and other structures suitable for roost creation that can legally be difficult to dispose of. If artificial roosts prove successful, as every indication has suggested, we can cooperatively solve a long-standing problem for the mining industry while providing new homes for bats nationwide. Artificial bat roost plans could become a routine part of reclamation, even at surface mines.

At their McLaughlin Mine in northern California, the Homestake Mining Company worked with bat biologist and BCI associate, Dixie Pierson, to build the first artificial bat roost. Made from old mine-truck tires connected by a precast concrete bunker, this artificial roost was buried under mine waste rock during surface mine-land reclamation.

At Solutia's Soda Springs Phosphate Mine in Idaho, BCI and mine managers used surplus large-diameter culverts to create both a hibernaculum and maternity roost for western big-eared bats. The culverts have been especially configured to hold stable cold air in the; winter and trap warm air in the summer and have been buried and contoured into the landscape during reclamation.

In a similar effort, Echo Bay's McCoy/Cove mine in Battle Mountain, Nevada used surplus mine-truck tires and old portable rescue buildings to create a haven for bats; and Canyon River Briggs Mine used cement drums and old mine-truck tires to help off-set habitat loss for Townsend's big-eared bats.

CONCLUSION

Why are so many agencies and mining companies concerned about bats? Because as a result of our mining history, essential habitats for a vital and fascinating wildlife species have been created. Agency and mining industry partnerships with BCI provide an excellent opportunity to demonstrate the benefits of mining, not only to the economy, but to the environment as well. In the future, BCI hopes to have bat conservation measures incorporated into all standard reclamation practices. By sharing responsibilities for conservation actions, by cooperating and partnering, and by being proactive, solutions will be reached that allow bats to thrive and all involved to garner the positive benefits.

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