

**BAT INVENTORY OF ABANDONED MINES:
BUREAU OF LAND MANAGEMENT - TUCSON RESOURCE AREA
(PIMA COUNTY, ARIZONA)**

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**Bat Inventory of Abandoned Mines:
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(Pima County, Arizona)**

Tim K. Snow and Shawn V. Castner

INTRODUCTION

Abandoned and inactive mines have become important resources for many of North America's bats. Nineteen of Arizona's 28 bat species use mines (Appendix 1). Some mines provide the necessary microhabitats for raising young during the summer, hibernacula during winter, and transitional oases during migrations. Others are used only as night roosts for resting, grooming, and digesting food.

Increased pressure for hazard abatement and mine reclamation has resulted in the closure of numerous underground mines, many times without proper biological assessments. These closures can have dramatic effects on an area's bat populations. For this reason, the Bureau of Land Management (BLM) contracted with the Arizona Game and Fish Department's Nongame and Endangered Wildlife Program (NGEWP) to begin a bat inventory of the abandoned and inactive mines on the BLM's Tucson Resource Area.

SURVEY AREA

The Tucson Resource Area, located within the BLM's Safford District, manages numerous tracts of land in Pima, Pinal, Graham, Santa Cruz, and Cochise counties (Fig. 1). Our specific study areas focused on BLM lands in the Tucson, Santa Rita, Sierrita, Cerro Colorado, and Las Guijas mountains. Habitats vary from Sonoran desertscrub to Madrean evergreen woodland (Brown 1994). Because of this diversity in habitats, most of Arizona's bat species could conceivably occur in the Tucson Resource Area (Appendix 1).

METHODS

A list of the mines to be surveyed was provided by the BLM. The list included mines located within possible land-swap evaluations or urban areas. BLM also provided hazard assessment notebooks that contained mapped locations, written directions, and photographs of each mine site.

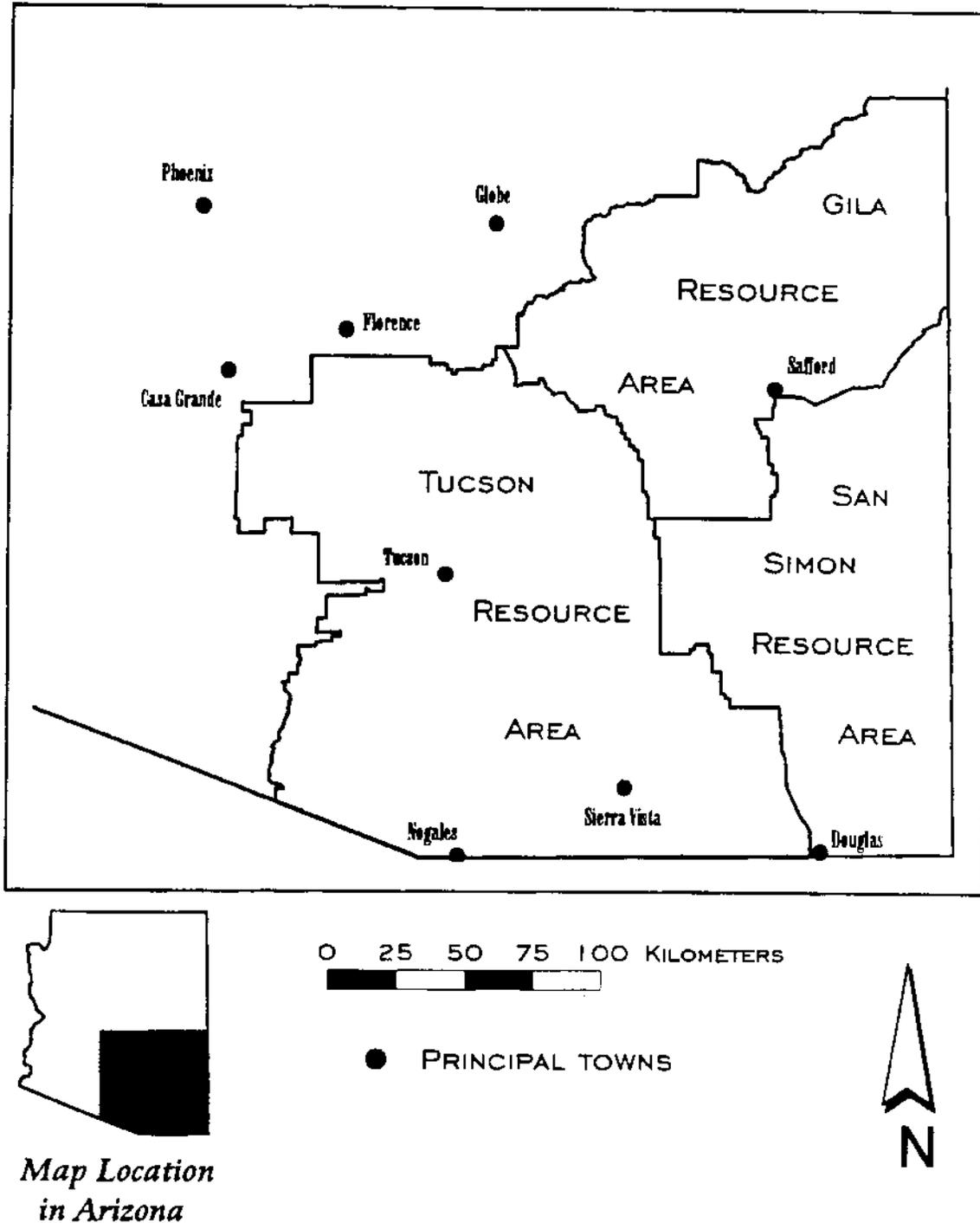


Figure 1. Bureau of Land Management - Safford District

Mines investigated during this survey consisted of adits, shafts, prospects, or combinations of these configurations. The mine site classification used was based on field experience and the various symbols used on USGS topographical maps. They include:

Adits - horizontal passages from the surface that vary in length from three to several hundred meters. These can be straight or with many twists and turns. It is possible to have additional drifts (horizontal passages) within adits.

Shafts - vertical entrances with depths greater than three meters. These may be straight or declining with varying slopes and may or may not contain drifts. Vertical shafts greater than nine meters (30 ft) or declines with slopes too steep to safely walk were not entered.

Prospects - small, shallow holes or scrapes constructed to prove claims or explore new areas. These do not exceed three meters in depth when shaft-like or length when adit-like.

Mines that appeared unsafe to enter were not surveyed. Safety concerns include stability of walls and ceilings, contaminated air, contaminated surface water on the mine floor, and use by potentially dangerous wildlife such as rattlesnakes, javelina, and mountain lions. Any mine deemed unsafe was noted for obtaining future bat exit counts.

Internal surveys consisted of exploring for evidence of bat use, such as guano deposits, skeletal remains, and bat presence. Data collected included date, observers, location of mine, mine name or corresponding mine number from the hazard assessment notebook, mine type (adit, shaft, prospect), aspect of entrance, temperature, relative humidity, and number and species of bats present. A map of the internal configuration was drawn along with any notes regarding specific bat roosting locations within the mine, visual sightings of other wildlife, and signs of human disturbance. A sling psychrometer was used to measure temperature and relative humidity.

Guano accumulations were measured according to the following scale: (1) no guano observed, (2) scattered or small piles (less than 30 centimeters in diameter or 3.8 centimeters high) present, and (3) large piles (greater than 30 centimeters in diameter or 3.8 centimeters high) or complete coverage of the floor.

RESULTS

We surveyed 216 mines between June 13 and July 19, 1995 (Table 1). Evidence of bat use was observed in 34 (15.7%) of the mines. Bats were present in 11 of the mines. Four sites contained

Table 1. 1995 Mines Surveyed on BLM's Tucson Resource Area (Pima County, Arizona)									
Quad Name	Month of Survey	Mines Surveyed	Guano Rating ¹				Mines With Bats	Species Present	
			1	2	3	U			
Batamote Hills	June	4	1	0	0	3	1	<i>Plecotus townsendii</i>	
Cat Mountain	June	33	28	3	1	1	1	<i>Myotis velifer</i>	
Brown Mountain	June	2	2	0	0	0	0	none	
Helvetia	June	25	16	6	1	2	2	<i>Choeronycteris mexicana</i> <i>Plecotus townsendii</i>	
Samaniego Peak	June	8	3	2	1	2	1	<i>Myotis velifer</i>	
Stevens Mtn.	June- July	65	38	11	4	12	6	<i>Myotis velifer</i> <i>Eptesicus fuscus</i> <i>Plecotus townsendii</i>	
Cerro Colorado	July	79	62	5	0	12	0	none	
Total		216	150	27	7	32	11	<i>C. mexicana, M. velifer</i> <i>E. fuscus, P. townsendii</i>	

¹Guano Rating: 1 = none; 2 = scattered or small piles; 3 = large piles or covering floor; U = unknown, survey incomplete.

significant populations with greater than 50 individuals. Four species were verified including Mexican long-tongued (*Choeronycteris mexicana*), southwestern cave myotis (*Myotis velifer*), big brown (*Eptesicus fuscus*), and Townsend's big-eared (*Plecotus townsendii*) bats. Three southwestern cave myotis and one Townsend's big-eared bat maternity sites were located.

We revisited 11 sites during February 3-5, 1996, to examine for winter use. Winter sites were selected based on observations of possible cold air traps, multiple entrances, or general layout of the mine made during our summer survey. Six of the 11 sites contained torpid Townsend's big-eared bats.

DISCUSSION

Bat Use

When analyzing the percentage of mines used by bats, it is important to distinguish those mines with roosting potential from those without (Table 2). Not all of the mines we surveyed contained probable roosting habitat. Two of the shafts and one adit were completely sealed by metal doors set in concrete, making access to the underground passages impossible. Additionally, most of the shafts we surveyed were test shafts of varying depths that did not contain any drifts. Although the potential for these types of shafts to contain roosting populations increases with depth (J. Scott Altenbach pers. comm.), it is unlikely that any of the test shafts we surveyed ever contain large bat populations or maternity roosts. The test shafts we surveyed have the potential to house a few individual bats, but lack the depth necessary for large roosts. Therefore, we have classified shafts like these as potential habitat, but not probable habitat.

Total Surveyed	Without Bat Habitat	With Potential Habitat	With Probable Roost Habitat		
			No Evidence of Bat Use	With Evidence of Bat Use	Percentage Showing Use
216	61	78	43	34	44.2

We found 44.2 percent (34) of the mines with probable roost habitat contained evidence of bat use, which is similar to our surveys in other areas of Arizona (Castner et al. 1994). Human disturbances may be the reason this percentage is not higher. Mines near Snyder Hill, Cat, Brown, Beehive and Stevens mountains all showed signs of heavy disturbance, including interior fires, gang/cult graffiti, trash dumping, foot prints, and all terrain vehicle uses.

Discrepancies in the mine inspector's notebooks may explain the high number of surveyed mines without roosting habitat (61). We observed many differences between our depth estimates and those described in the notebook. For example, Stevens Mountain mine 26-19 is listed in the notebook as being greater than 20 feet deep. Our depth estimate was only 3 feet. We verified this site by the hazard sign number and the presence of an old refrigerator in the bottom of the mine. A photograph in the assessment book shows the refrigerator with portions of the mine's floor exposed underneath. It is possible that differences occur in the methods we use to estimate depth and those used in hazard assessments.

All mines had to be surveyed in some areas, because of mismapped locations in the mine assessment notebook. For instance, Helvetia Mine 15-14 was located on the opposite side of a canyon and road than the mapped location. It was much easier to visit all sites than to spend excessive time searching for one site. Therefore, creating a priority mine survey list based on these notebooks may not always omit mines without potential or probable roost habitat.

Winter Use

Internal temperatures probably account for the low number of hibernacula that we found. The largest hibernaculum we found contained five torpid Townsend's big-eared bats. Internal temperatures ranged from 7° C (45° F) to 16° C (62° F) with an average of 12° C (53.6° F). These temperatures appear too high to sustain hibernation for most species of bats.

Unsurveyed Mines

We did not conduct surveys at 28 mines because of safety reasons (Appendix 2). Most were shafts greater than 30 feet deep that contained drifts or sites with impassable internal raises or winzes. The Cerro Colorado mine 25-4 was not surveyed because of a bee attack.

Some areas could not be surveyed because of access problems through private property (Appendix 2). The Good Enough Mine area appeared to be active with people living on site. We also encountered posted "No Trespassing" areas surrounding McCafferty Canyon in the Las Guijas Mountains that prevented access. In an effort to expedite the survey, land owners were not contacted and the sites were omitted.

MANAGEMENT RECOMMENDATIONS

1. An alternative closure method, such as gating, should be performed at the four maternity roost sites and the six hibernacula that we encountered. This is especially important at the 400 yard mine where gang graffiti is painted on the walls at the portal. In addition, even though only one bat was observed at the Helvetia 15-15A mine, this mine should receive bat friendly gates due to the large amount of guano.
2. Exit counts should be conducted at the 15 sites where a complete survey was not performed, but which contained probable roosting habitat (Appendix 2).
3. Roads on the west side of Stevens Mountain should be removed or blocked to prevent all vehicle access including quadrunners. We found two large maternity sites in this area, including one of the largest Townsend's big-eared bat colonies in Arizona. Considering the high summer temperatures, blocking vehicle access may prevent most disturbances to these mines during the maternity season.
4. Roost monitoring is a critical component for any conservation plan directed towards bats. We realize that it may be impossible, as well as impractical, to regularly monitor all sites where evidence of bat use is found. We suggest monitoring the four maternity roosts verified during this survey. Significant sites, such as these, should be monitored yearly during each season of use. Exit counts are the preferred method for any monitoring activities undertaken.
5. Because this survey was not inclusive of all areas within the Tucson Resource Area, we recommend that bat mine roost surveys be expanded to other areas as well. We were only able to verify four of the 19 known bat species that utilize mines. Other surveys may show a larger diversity existing in the Tucson Resource Area.
6. Although we did not conduct mist netting surveys during this project, we suggest implementation of such surveys to supplement the data gathered during mine roost surveys. Mist netting surveys may identify areas containing possible maternity roosts or large bat populations that may not be observed during mine roost surveys.

CONCLUSIONS

This report is a compilation of the data collected during the 1995 bat mine roost survey on the BLM's Tucson Resource Area. We were successful in locating four maternity roosts and six hibernacula during this survey. The 44 percent of mines showing evidence of use demonstrates the importance of these human made structures. In addition to the bats, we located one of only six known turkey vulture (*Cathartes aura*) nest sites in Arizona.

Exact locations of the surveyed mines have been omitted from this report in an attempt to protect sensitive colonies. The NGEWP bat management project is following the guidelines recommended by the American Society of Mammalogist's Conservation of Land Mammals Committee (Sheffield et al. 1992) which states revealing exact locations of bat roosts may result in declines in populations, damage to roosts or both. Land management agencies requiring more specific data should contact the Arizona Game and Fish Department's Heritage Data Management System.

While the information gained during this survey is valuable, additional roost surveys, implementation of netting surveys, and roost monitoring will provide more accurate data on seasonal uses, population trends, and management needs for bats utilizing the Tucson Resource Area. It is through projects like this one that we are beginning to answer some of the many questions regarding life history, habitat requirements, and seasonal movements of Arizona's bats. With persistent efforts, collaborative surveys, and cooperative funding, similar to what took place during this project, we will be able to confidently devise management strategies that will conserve bats in Arizona.

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Appendix 1. Bats of Arizona

Common Name Scientific Name	Tucson RA	Habitat	Roost Structure
Ghost-faced bat <i>Mormoops megalophylla</i>	Possible	Desertscrub to Mesquite Grassland, Riparian	Caves/mines
Mexican long-tongued bat <i>Choeronycteris mexicana</i> *	Expected	Desertscrub to Mixed Oak-Conifer	Caves/mines
Lesser long-nosed bat <i>Leptonycteris curasoae</i> *	Expected	Desertscrub to Oak Woodland	Caves/mines
California leaf-nosed bat <i>Macrotus californicus</i> *	Expected	Sonoran Desertscrub below 1220 m	Caves/mines
Yuma myotis <i>Myotis yumanensis</i>	Expected	Desert to Pinyon-Juniper, forages over open water	Caves/mines, buildings
Cave myotis <i>Myotis velifer</i>	Expected	Desert; may hibernate in mines/caves above 1825 m	Caves/mines, bridges
Arizona myotis <i>Myotis lucifugus occultus</i>	Expected	Desertscrub to Pine	Caves/mines, tree cavities
Long-eared myotis <i>Myotis evotis</i>	Unlikely	Pinyon-Juniper to Mixed Conifer	Caves/mines, tree cavities
Southwestern myotis <i>Myotis auriculus</i>	Expected	Desertscrub to Pine	Caves/mines, tree cavities
Fringed myotis <i>Myotis thysanodes</i>	Expected	Chaparral to Pine	Caves/mines
Long-legged myotis <i>Myotis volans</i>	Possible	Ponderosa Pine to Mixed Conifer, Desertscrub during migrations	Caves/mines, buildings
California myotis <i>Myotis californicus</i>	Expected	Desert to Pine	Caves/mines, crevices
Small-footed myotis <i>Myotis ciliolabrum</i>	Possible	Oak transition to Pine	Caves/mines, crevices
Silver-haired bat <i>Lasionycteris noctivagans</i>	Possible	Ponderosa Pine to Mixed Conifer	Tree bark, buildings
Western pipistrelle <i>Pipistrellus hesperus</i>	Expected	Desert to Pine	Caves/mines, crevices
Big brown bat <i>Eptesicus fuscus</i>	Expected	Desertscrub to Mixed Conifer	Caves/mines, buildings

* = Arizona Game and Fish Department *Wildlife of Special Concern* list (AGFD in prep)

Appendix 1 (cont.) Bats of Arizona

Common Name Scientific Name	Tucson RA	Habitat	Roost Structure
Western red bat <i>Lasiurus blossevillii</i> *	Expected	Broad-leafed Woodlands, Riparian	Tree foliage
Western yellow bat <i>Lasiurus xanthinus</i> *	Possible	Broad-leafed Riparian, Ornamental Palm trees	Tree foliage
Hoary bat <i>Lasiurus cinereus</i>	Expected	Desertscrub to Mixed Conifer	Tree foliage, bark
Spotted bat <i>Euderma maculatum</i> *	Unlikely	Desertscrub to Pine, Xeric communities near cliffs	Cliff crevices
Allen's lappet-browed bat <i>Idionycteris phyllotis</i>	Unlikely	Ponderosa Pine, Mohave desertscrub in winter	Caves/mines, tree cavities
Townsend's big-eared bat <i>Plecotus townsendii</i> *	Expected	Desert to Pine	Caves/mines, buildings
Pallid bat <i>Antrozous pallidus</i>	Expected	Desert to Pine	Caves/mines, buildings
Mexican free-tailed bat <i>Tadarida brasiliensis</i>	Expected	Desert to Pine	Caves/mines, bridges
Pocketed free-tailed bat <i>Nyctinomops femorosaccus</i>	Expected	Desert to Chaparral	Cliff crevices, buildings
Big free-tailed bat <i>Nyctinomops macrotis</i>	Possible	Desertscrub to Pine	Cliff crevices
Western mastiff bat <i>Eumops perotis</i>	Possible	Desert to Pine	Cliff crevices
Underwood's mastiff bat <i>Eumops underwoodi</i>	Possible	Desert to Mesquite Grassland	Cliff crevices

* = Arizona Game and Fish Department *Wildlife of Special Concern* list (AGFD in prep)