BAT INVENTORY OF THE WET BEAVER CREEK WILDERNESS AREA (COCONINO COUNTY, ARIZONA)

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INTRODUCTION

Bats play an important role in nearly every ecosystem in the world, and the Southwest is no exception. Arizona's 28 species of bats are major predators of insects, including those that feed on agricultural plants. Also, two species are the primary pollinators of agave and columnar cacti.

The main threats to most bats is the loss of roosting and foraging habitat. Many types of roosts exist, such as mines, caves, buildings, cliffs, and trees. Several species rely exclusively on underground structures for roosts and form colonies numbering from hundreds to thousands of individuals. Many or all of the bats in an area may be concentrated in one roost, so the loss of even one roost can have serious impacts. Loss or alteration of habitat other than roosts can also threaten the future of bats in an area. If traditional food sources, such as insects or agaves and columnar cacti, are unavailable, the area may become uninhabitable.

The Arizona Game and Fish Department recognized the need to conserve bat resources and created the Bat Management Project (BMP). Inventory of the Wet Beaver Creek Wilderness Area (WBCWA) and nearby canyons are among the objectives of the BMP. This inventory was designed to document species occurrence and roosts.

SURVEY AREA

The WBCWA is 6,700 acres of rugged canyon country located on Beaver Creek and Long Valley Ranger Districts, Coconino National Forest, in central Arizona (Fig. 1). The upper boundary is in Coconino County above the confluence of Jacks and Brady Canyons. From there, the Wilderness follows the canyon system along Wet Beaver Creek into Yavapai County with its lower boundary above the Beaver Creek Ranger Station. Elevations range from 4000 to 6300 feet. Vegetation at the upper elevations is primarily ponderosa pine (*Pinus ponderosa*) and Gambel's oak (*Quercus gambelli*) with Upper Sonoran Desert at lower elevations (Brown 1994).

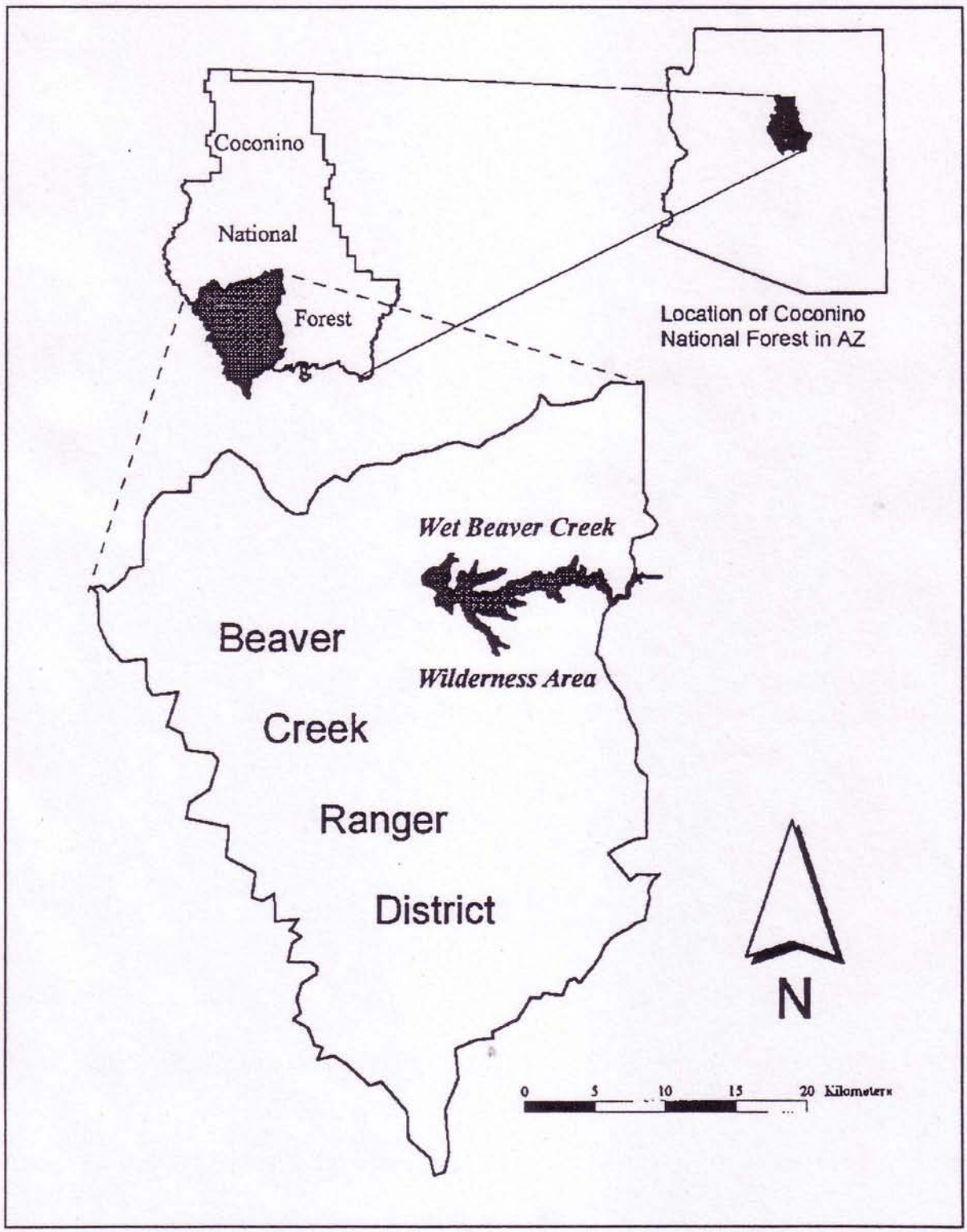

Figure 1. Location of the Wet Beaver Creek Wilderness Area.

Species Occurrence

Our museum and literature search revealed that no comprehensive bat survey has been conducted and very few, if any, species occurrence records exist within the WBCWA. Because many specimens lacked specific locality information, we were unable to definitively assign any specimens capture locality within the political boundaries of the WBCWA.

We found only two potential occurrence records for the WBCWA. The location given for both was merely "Wet Beaver Creek," so whether they were captured within the wilderness boundary is unknown. The adjacent area had records for 16 additional species. All 18 likely occur on the WBCWA, and an additional five species are potential inhabitants. Table 1 lists these bats, along with their typical habitat, and primary roosting structure.

Methods

The primary method employed during this survey was mist netting. Mist nets were set in the canyon bottom over water when possible. Sites with still pools of water and/or with narrow flyways above the stream were selected for netting. The number and size of nets varied according to the characteristics of each site. We used 30-50 denier, 2 ply black nylon nets with a 3.8 cm mesh. Data collected at each site included date, location, legal description, habitat description, number and size of nets used, participants, starting and ending time, and diagram of the net set. Data collected for each bat included species, sex, age, reproductive condition, weight, length of forearm, and time of capture.

We assessed any adverse netting conditions (wind, rain, and moon) that were encountered at each location recorded the time each condition began and its duration. Overall netting conditions were classified as follows:

excellent	no adverse conditions.
good	one adverse condition for less than 25 percent of net time.
fair	one or more adverse conditions for less than 50 percent of net time.
poor	one or more adverse condition for more than 50 percent of net time.

Roost sites were surveyed whenever possible. These examinations were conducted as we came across sites that had a high potential for roosting. Most of the sites were shallow caves, but several cliff crevices and trees were also checked for evidence of bat use. Data collected included location, site description, and bat sign.

Table 1. Bat species likely to occur on the Wet Beaver Creek Wilderness Area.

Common Name Scientific Name	Habitat	Roost Structure
California leaf-nosed bat *Macrotus californicus*	Sonoran Desertscrub below 1220 m	Caves/mines
Yuma myotis *Myotis yumanensis*	Desert to Pinyon-Juniper, forages over open water	Caves/mines, buildings
Cave myotis *Myotis velifer*	Desert; may hibernate in mines/caves above 1825 m	Caves/mines, bridges
Arizona myotis *Myotis lucifugus occultus*	Desertscrub to Pine	Caves/mines, tree cavities
Long-eared myotis *Myotis evotis*	Pinyon-Juniper to Mixed Conifer	Caves/mines, tree cavities
Southwestern myotis *Myotis auriculus*	Desertscrub to Pine	Caves/mines, tree cavities
Fringed myotis *Myotis thysanodes*	Chaparral to Pine	Caves/mines
Long-legged myotis *Myotis volans*	Ponderosa Pine to Mixed Conifer, Desertscrub during migrations	Caves/mines, buildings
California myotis *Myotis californicus*	Desert to Pine	Caves/mines, crevices
Small-footed myotis *Myotis ciliolabrum*	Oak transition to Pine	Caves/mines, crevices
Silver-haired bat *Lasionycteris noctivagans*	Ponderosa Pine to Mixed Conifer	Tree bark, buildings
Western pipistrelle *Pipistrellus hesperus*	Desert to Pine	Caves/mines, crevices
Big brown bat *Eptesicus fuscus*	Desertscrub to Mixed Conifer	Caves/mines, buildings
Western red bat *Lasiurus blossevillii*	Broad-leafed Woodlands Riparian	Tree foliage
Hoary Bat *Lasiurus cinereus*	Desertscrub to Mixed Conifer	Tree foliage
Spotted Bat *Euderma maculatum*	Desertscrub to Pine near cliffs	Cliff crevices
Allen's lappet-browed bat *Idionycteris phyllotis*	Ponderosa Pine	Caves/mines tree cavities
Townsend's big-eared bat *Plecotus townsendii*	Desert to Pine	Caves/mines buildings
Pallid bat *Antrozous pallidus*	Desert to Pine	Caves/mines buildings
Mexican free-tailed bat *Tadarida brasiliensis*	Desert to Pine	Caves/mines buildings
Pocketed free-tailed bat *Nyctinomops femorosaccus*	Desert to Chaparral	Cliffs buildings
Big free-tailed bat *Nyctinomops macrotis*	Desertscrub to Pine	Cliffs
Western mastiff bat *Eumops perotis*	Desert to Pine	Cliffs

RESULTS

Mist netting was conducted at nine locations on the WBCWA (Fig. 2) during July and August 1996. We captured 12 individuals representing five species (Table 2) including *Antrozous pallidus*, *Idionycteris phyllotis*, *Myotis auriculus*, *Myotis ciliolabrum*, and *Myotis yumanensis*. One *Myotis volans* may have been captured, but it escaped from the net before we could verify the species identification. Also, vocalizations of *Nyctinomops macrotis* were heard at the Brady Canyon, Waldrop Canyon, and Section 13 netting sites.

Table 2. Results of mist netting conducted on the Wet Beaver Creek Wilderness Area.

Netting Location	Legal Description (UTM)	Date	Net Hours	Netting Condition[1]	Capture Results
Gaging Station	E438380, N3837040	7/23/96	2.25	fair	*Myotis yumanensis* (1)
Long Canyon	E439500, N3836140	7/24/96	4	good	*Myotis yumanensis* (2)
Brady Canyon	E453415, N3838170	8/12/96	8	excellent	*Idionycteris phyllotis* (1) *Nyctinomops macrotis* (echo)
Waldrop Canyon	E447780, N3838190	8/13/96	4	fair	*Antrozous pallidus* (2) *Nyctinomops macrotis* (echo)
Section 13	E449180, N3838110	8/14/96	5	good	*Antrozous pallidus* (2) *Myotis auriculus* (1) *Myotis ciliolabrum* (2) *Myotis* sp. (*volans*?) (1) *Nyctinomops macrotis* (echo)
West Waldrop	E447530, N3838080	8/20/96	4	fair	none
Fritz Canyon/Beaver	E446100, N3837800	8/21/96	8	poor	none
Fritz Canyon	E446170, N3837700	8/21/96	2.5	poor	none
Totals			37.75	N/A	*Myotis yumanensis* (3) *Myotis auriculus* (1) *Myotis ciliolabrum* (2) *Myotis* sp. (*volans*?) (1) *Idionycteris phyllotis* (1) *Antrozous pallidus* (4) *Nyctinomops macrotis* (echos)

[1]Netting Condition: excellent-no adverse conditions, good-one adverse condition for less than 25% of net time, fair-one or more adverse conditions for less than 50% of net time, poor-one or more adverse conditions for more than 50% of net time.

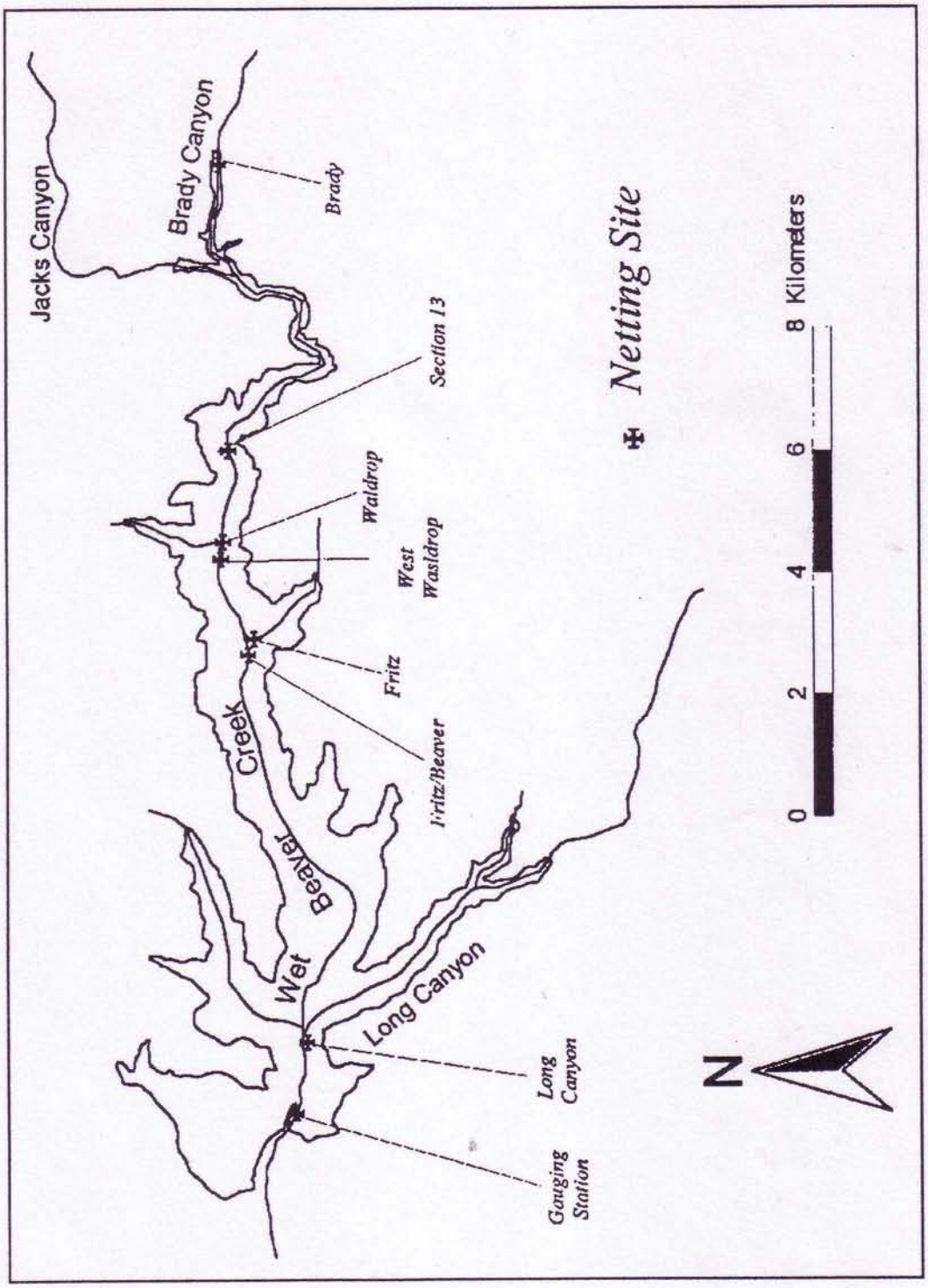

Figure 2. Location of net sites on the Wet Beaver Creek Wilderness Area.

We encountered numerous caves along the creek with evidence of bats roosting, however all appeared to be used infrequently and by few (<5) bats. A crevice contained at least twenty bats, but species and colony size could not be determined due to time constraints. We also located a roost in a knot hole in a branch of a sycamore (*Platanus wrightii*) tree, extending over a dry portion of the creek. Both the crevice and knot hole were used regularly, as evidenced by the amount of guano deposited and large urine stains below the roost.

DISCUSSION

Capture Success

This survey was intended to gather preliminary data on the bat fauna occurring on the WBCWA. As with any netting survey, we did not expect to capture all species that may occur on the WBCWA. However, we did expect to capture more than five species. Of the 24 possible species, we expected to document at least 12, based on habitat characteristics and netting efforts.

Many potentially productive sites could not be netted because of physical characteristics, such as vertical cliffs, deep water, or dense vegetation, that limited access. Although steep-walled canyons typically concentrate bats, the vertical stratification of habitat types and corresponding insect types found in the WBCWA probably segregates species based on roosting and foraging preferences. Continuous availability of water along the creek may make sampling bats more difficult, since animals are not spatially concentrated at a single water source.

Many other factors affect netting success other than the absence of bats. Climatic conditions such as wind, rain, storm fronts, moonlight, temperature or synergistic combinations of these conditions may decrease capture rates. Wind causes the nets to move and stretch, making them more detectable by bats. Moonlight makes the nets more visible to bats. Adverse weather can result in bats remaining closer to their roosts. In the extreme, these conditions can cause bats to remain in their roost the entire evening.

Wind was the primary adverse condition we experienced, usually occurring prior to and just after sunset. This is the time when the majority of bats are usually caught. Every night had at least 30 minutes of wind, and on three occasions, it blew all night. It rained only once on survey nights, but there were storms in the vicinity every night that may have affected bats' behavior. Moonlight may have been a factor, but the nets were shaded by trees and the canyon walls most of the evening. Of the nine net nights, two were classified as poor, three as fair, two as good, and one as excellent (Table 2). This indicates that our potential for capturing bats was less than optimal.

Foraging behavior can also influence capture rates and diversity within a given area. Many bat species (most notably, members of the *Molosidae* family or free-tailed bats) forage at altitudes higher than our nets and are captured only when they come down to drink. Since there are

abundant watering locations along the creek, the probability of capturing these species is low. This may explain why big free-tail echolocation calls were heard even though we did not collect this species.

Another factor that may have affected our capture results was season. Our survey was conducted after the maternity season and bats may have already begun migrations out of the area. Although bats typically disperse after the maternity season, complete migrations usually do not occur until immediately prior to hibernation, routinely in late September or October. Monsoonal activity was heavy this year, however, and could have caused bats to disperse prematurely.

Bat activity can vary year to year for an area, and this may have been a down year. Conversations with other biologists netting in Arizona indicated that netting results were not what they expected, with both species and capture numbers being low. Excessive drought conditions during the winter and spring prior to this survey may have had more influence on bat populations than we anticipated.

Roost Sites

Roost surveys were limited to the canyon floor. We did not conduct a comprehensive survey of potential roost sites on the WBCWA. It was not surprising to observe incidental bat sign in nearly every cave and overhang we visited. These sites typically had several pieces of guano scattered about along with culled insect parts indicative of night roosting bats. We did not observe any evidence of long term roosting except for the two localities mentioned previously. However, we do not suggest that these are the only roosts within the WBCWA. In fact, because of the terrain and continuous canyon walls, we expect that WBCWA contains many important roost sites in the region. Unfortunately, we were unable to access many structures high above the canyon floor that may house bat colonies.

MANAGEMENT RECOMMENDATIONS

Based on these limited data, it is difficult to provide a detailed plan for managing bats on the WBCWA. We will provide general guidelines for protecting bats. We encourage a more comprehensive survey be conducted to provide a more accurate assessment of bat use on the WBCWA. More information is required to effectively manage the area with a particular goal.

We noticed fire residues in some caves and overhangs along the creek, especially near the lower end. Fires have both immediate and long term impacts. Smoke from fires tends to hang in the canyon bottom and may affect insect and bat activity along this important foraging corridor. Smoke from fires may drive bats out of the roost while deposition of soot and residues may render the roost uninhabitable. If alternative roosts are unavailable or if nonvolant young are present these activities may result in significant mortality. We recommend prohibiting the use of open fire in the canyon bottom. In addition to preventing the destruction of roost habitat in

the canyon, banning the use of fire in the canyon would also benefit the riparian corridor. Harvest of down wood, attempts at burning non-burnable refuse such as plastics and aluminum, unsightly fire rings, and the potential for contamination of the stream with fire residues would all be abated by prohibiting fire in the canyon bottom.

Provided the WBCWA remains in its current state, it should have the potential to support healthy bat populations. To effectively manage the WBCWA for bats, managers must first obtain baseline data on occurence and roost sites. Because of the vulnerability of colonial species to roost-specific threats, identification of roost sites is a first priority. Monitoring programs can later be designed based on this information. Budget limitations often make this difficult, but without these data, we can not be confident that management decisions are not adversely impacting the species of concern.

CONCLUSIONS

This report summarizes data collected during the 1996 bat survey of the WBCWA. Although we did not obtain the expected number of species and total captures, we believe that surveys conducted earlier in the maternity season would produce better results. The 12 individuals and seven species we encountered undoubtedly do not represent the complete bat community present on the WBCWA.

Exact locations of the roosts have been omitted from this report in an attempt to protect sensitive colonies. This follows 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 netting, roost surveys, and roost monitoring will provide more accurate data on seasonal uses, population trends, and management needs for bats using the WBCWA. It is through projects like this 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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