

BAT SURVEY OF THE BILL WILLIAMS RIVER
Fiscal Years 1994-1996

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Conducted for:
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Funding Provided by:
Arizona Game and Fish Department Heritage Fund
Project Number I93073

Final Report
March 28, 1996



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ABSTRACT

Bats were surveyed along the Bill Williams River (BWR) corridor from Alamo Dam to Lake Havasu between December 1993 and October 1995, with at least one survey period in each season of the year. Survey methods included mist-netting; mine and diurnal roost surveys; radio-telemetry to locate roosts of targeted species; and detection of bat sonar signals. During this survey, 13 species of bats were identified using the BWR corridor, and day or night roosts were located for 12 of these species. All 13 species were captured at least once in mist nets, with evidence of reproduction in all but hoary, yellow and western mastiff bats. The California leaf-nosed bat roosted in several mines within a mile corridor of the BWR, with different mines being used in the winter, maternity and fall courtship periods. Two mines were identified with maternity colonies of Townsend's big-eared bats and five mines sheltered maternity colonies of the cave myotis. Radio-telemetry revealed hoary and yellow bats day-roosting in trees along the BWR. No roosts were found for the western mastiff bat, but sonar signals were heard as these bats flew over the Lincoln Ranch and the Planet Ranch on several occasions. Management recommendations are to gate some of the bat mine roosts that are frequented by people.

INTRODUCTION

The purpose of the current survey was 1) to identify bat species in the Bill Williams River corridor below Alamo Dam, with special attention given to those species listed as Threatened Native Wildlife by the Arizona Game and Fish Department (AGFD); 2) to identify roost sites along the corridor for the California leaf-nosed bat; and 3) to provide management recommendations to Federal and State agencies for the protection of bat species using the Bill Williams River corridor.

Dams and development along Colorado River have eliminated much of the riparian habitat. Thus the lush vegetation in the wilderness areas along the Bill Williams River downstream of Alamo Dam are a remaining magnet for a variety of wildlife, including bats. Limited field work on bats had been conducted along the river corridor to date. During a 1972 survey, the author documented a sizable winter population of about 400 California leaf-nosed bats (*Macrotus californicus*) roosting in a mine adit near the ghost town of Planet. In winter 1992-93, Arizona Department of Fish and Game biologists surveyed many of the mines in the area, and found fewer *Macrotus* roosting in a different adit than that occupied in 1972.

Returning to this area in December 1993, the author discovered that the main winter colony of over 700 bats had shifted to the War Eagle shaft in the southwestern part of the Planet workings, with some *Macrotus* or their guano present in 30 of the 35 mine workings near Planet that were entered. Also during this survey, solitary Townsend's big-eared bats (*Corynorhinus*=*Plecotus townsendii*) were observed hibernating in the War Eagle and in a sandstone cave. Other than the Planet area, the only mine visited on this survey was located a half mile north of the Bill Williams River across from the Rankin Ranch, and contained a winter *Macrotus* colony and guano indicative of a large summer cave myotis (*Myotis velifer*) roost. *Macrotus*, *Corynorhinus* and *Myotis velifer* are all former C2 Candidate species under the Endangered Species Act.

Macrotus belongs to the Neotropical family Phyllostomatidae. As with other members of the family, this species is unable to lower its body temperature and enter torpor as do other temperate zone bats. Consequentially, *Macrotus* selects warm mines and caves as roosts usually with year-round temperatures above 80 F. Their distribution throughout the Sonoran and Colorado Deserts is determined by the availability of warm roosts near the desert washes, where they forage by gleaning large insects from the vegetation. Radio-telemetry studies in California have shown that, in the winter, bats usually forage in desert riparian vegetation within a mile of their roosts, but in warmer months, they may travel up to 5 miles. Some of the threats to this C2 Federal Candidate are the closure of abandoned mines for hazard abatement or renewed mining, and roost disturbance by vandals or recreational mine explorers.

Townsend's big-eared bat is considered to be declining in numbers throughout its range (Idaho State Conservation Effort, 1995). Although several contributing causes are cited, the greatest threat is from roost disturbance. This cave and mine roosting species is very sensitive to human entry, especially during maternity and hibernation seasons. Temperature appears to be the key factor in roost selection, with cooler areas necessary for winter torpor and warm temperatures desirable for maternity colonies.

During the December 1993 survey, the staff of the Planet Ranch were interviewed regarding bat sightings. Alan Chase lived at the ranch for 8 years. He verbally described and then identified from photographs, western mastiff (*Eumops perotis*) and lesser long-nosed bats (*Leptonycteris curasoae*) as having been removed from the swimming pool at the ranch during the "hot" months. He also had heard and seen large bats exiting from cliff faces on the north side of the River upstream from Planet Ranch. This description could possibly indicate a *Eumops* roost, and was an impetus for further surveys.

METHODS

Field work under the AGFD Heritage Fund was conducted in each season: from May 19-24, 1994, September 30-October 7, 1994, January 17-22, 1995, July 9-16, 1995 and October 3, 1995. Planet Ranch was used as the base of operations for most surveys. Field personnel included Dr. Patricia Brown, Dr. Robert Berry and Cathi Brown, and the following people assisted at some time during the survey: Shawn Castner, Tim Snow, Jim Witham, Dan Preskorn, Angie McIntyre, Bill Ough, and Mike Senn (Arizona Game and Fish Department); Jim Rorabaugh, Barbara Raulston, Nancy Gilbertson, Chuck Minckley and Ron Kearns (U.S. Fish and Wildlife Service); Sarah Hooper, Susanna Henry and Elroy Masters (Bureau of Land Management); Karen Miner-Pluff (California Department of Parks and Recreation); Christine Bates (Marine Corps Air Station, Yuma); Ron Hill (City of Scottsdale, Planet Ranch) and unaffiliated volunteers Greg Bates, Wolf Lambrecht, Bob Pluff, Brett Buescher, and Scottie and Roger McKasson. Field techniques included entering mines at different seasons to search for bats or guano, counting mine outflights with the aid of night vision equipment, mist netting outside of mines and over water sources, searching under cliffs and rock crevices for evidence of bat use, monitoring sonar signals at night with ultrasonic detection equipment, and radio-telemetry of selected bats captured in mist nets.

Mines provide ideal day and night roosts for several species of cave- and crevice-roosting bats. If the mine could be totally accessed, the bats and guano were identified. Within the mine, bats often were captured in hand nets for identification and information on age, sex and reproductive condition. Most bat guano was identified as to genus by size, shape, odor and deposition pattern, even when the bats were not present. The amount of guano can be related to population size. Temperatures were taken in the accessible areas of the mines that the bats used for roosting. If guano and/or insect remains were found during the day, but no bats were present, then the mine was revisited at night or in another season to identify bat use. In the case that the mine entrance was a vertical shaft or the horizontal adits contained inaccessible areas (raises, winzes, stoped areas or deep crevices), then the presence of bats was detected by watching the portals for at least an hour after dusk for bat emergence. Generation 3 Varo night vision equipment with auxiliary red or infrared light sources was used to monitor bat activity. To count the outflights, finger tallies were employed with the net number of bats determined by subtracting the number of bats entering from those leaving the mine. If identification could not be made on the basis of size and flight pattern of the bat, then mist-netting at mine entrances was sometimes employed.

Other potential roosts used by bats include trees, rock crevices, natural caves, buildings and other manmade structures, and these were surveyed for bats and guano whenever possible. Unless obvious cavities are apparent in trees, it is difficult to locate bats. The same is true for rock-roosting bats, unless guano or staining is found under the crevice. Radio-telemetry is a valuable tool for locating bat roost locations, unless the bat is roosting beneath the ground (i.e. mine) or in a deep crevice. To this end, selected bats (weighing at least 15 grams) captured in mist nets over the BWR were fitted with Holohil .5 gram transmitters (in the 150-151 MHz range) affixed to the back with skin-bond cement. Using two tunable receivers (AVM LA-12 and Telonix) with directional antennas, the bats were tracked at night while foraging and night-roosting, and during the day to roosts (whenever possible). On two occasions, assistance in locating the bats was provided by an AGFD airplane..

Mist nets of various sizes were spread for at least 4 nights at each season (excluding winter) in various spots along the BWR from Alamo Dam to the Bill Williams National Wildlife Refuge. Two to three nets were set each night for at least two hours after dusk and continuously checked. For one night each season, the nets were tended from dusk until dawn, in an effort to capture late-flying bats, such as the spotted bat (*Euderma maculatum*). All bats captured were immediately removed, identified as to species, sex, age and reproductive condition. Weather conditions were also recorded.

Sonar signals of bats were monitored using several varieties of bat detectors: Anabat 2, Ultrasound Advice mini-detector, and Pettersson D-100, D 230, and D-980 detectors. The Anabat 2 detector with a delay switch and tape recorder was used to remotely record bat signals with a time stamp. The main purpose of the detectors was to determine bat foraging habitat for future mist-netting sites. Some species (*Macrotus* and *Corynorhinus*) emit echolocation calls too faint too be detected except at very short distances. Most vespertilionids utilize signals that overlap in frequency depending on the bats perceptual task. In some cases (i.e. *Tadarida*), species identification was possible using a detector. Several species of bats (*Euderma*, *Eumops* and *Nyctinomops*) emit lower frequency signals audible to (younger) human ears without a detector. Other species, such

as *Antrozous* and *Macrotus*, use human-audible communication sounds. A custom University of Tübingen (German) detector was employed to record signals associated with the *Macrotus* courtship display.

Mine roosts and mist-netting locations were usually photographed and locality information was derived from 7 1/2 minute topographic maps and/or a Global Positioning System receiver (Micrologic Supersport). A Canon A-1 Digital camera was used to video-tape the courtship behavior of *Macrotus*.

RESULTS

A total of 13 species of bats were detected during the Bill Williams River Survey between May 1994 and October 1995 (Table 1). Of these over 75% (10) showed evidence of reproduction (pregnant, lactating or post-lactating females or juveniles). Only male hoary and yellow bats (*Lasiurus cinereus* and *xanthinus*) were captured, and most of these were during the time of migration. The high-flying western mastiff bats (*Eumops perotis*) were heard at all seasons except winter. Only one was mist-netted in July 1995, but escaped from the net before any data could be gathered.

Roost Surveys:

Of the 13 species of bats detected during this survey, at least one day roost locality was found for over half (8 species), and 4 more species were discovered at night roosting in mines. On December 5, 1993 two torpid *Corynorhinus* were discovered in a natural sandstone cave located southwest of the gas pipeline crossing. Guano attributable to *Tadarida* and/or *Nyctinomops* was found under the high cliffs located north of the BWR about 5 miles upstream of the main Planet Ranch buildings, and bats were heard as they emerged from their roosts after dark in the summer. As a result of the radio-telemetry, hoary and yellow bats were discovered roosting in trees along the BWR and elsewhere. They will be discussed in more detail in the radio-telemetry section.

Most of the bat roosts discovered during this survey were in abandoned mines. In May 1994, an airplane flight over the BWR helped to locate mines and delineate access to them. Since mines are easier to quantify than other kinds of potential roost sites, a sampling bias exists. Most of the mines do not have specific names, they were assigned numbers that correspond to those on the map. During the course of the survey, over 65 mine features (Table 2) were surveyed for bats, 50 of them in the area around Planet. All but 4 shafts were able to be partially entered to look for bats and/or guano. Since many of the workings had multiple openings and possible connecting drifts, raises and winzes, an accurate assessment was at times difficult. Most of the mines entered had bats or significant guano deposits, indicating bat use at some time of day or season of the year. Only one shaft in the Planet area with 2 resident barn owls had no bat sign present. Most of the guano was left by *Macrotus*, but many workings also contained piles of guano of cave myotis (*Myotis velifer*), long-eared (*Corynorhinus*), big brown (*Eptesicus fuscus*) and pallid bat (*Antrozous pallidus*), with scattered small *Myotis* guano in many. The first three species were encountered during diurnal surveys, while big brown and pallid bats were usually only visible at night. They may have been concealed in crevices during diurnal surveys, or entered the mines after dark for night roosting. This behavior is often observed for California myotis and western

pipistrelles. Manmade bat roosts other than mines were the flume tunnels along the south side of the BWR upstream from Lincoln Ranch that served as day roosts for male *Macrotus* and night roosts for male and female *Macrotus* as well as *Myotis yumanensis*.

Exit counts were conducted on 10 mines that were known to contain large numbers of bats. Some of these mines had multiple entrances to a single mine complex, and required up to 5 observers for an outflight count (i.e. Argus). Three mines were watched because they could not be safely entered or had areas within the mine that were impossible to survey. Five mines were surveyed at different times of the year to observe changes in the numbers or species composition. The War Eagle shaft was monitored four times so bat use at all seasons could be compared. The more significant mine roosts are described below.

Planet Area

There are over 50 mine openings in the Planet area. Some are interconnected, and a few have been assigned separate names after research by AGFD biologists. Almost all of the mine features contain guano (usually *Macrotus*), and the majority have significant amounts. Both seasonally and between years, the bats occupy different mines and areas within mines, so the Planet complex probably houses a single population.

1) War Eagle #1 shaft (names and numbers from AGFD biologists) is a major winter *Macrotus* roost. The winter evening exit counts of December 1993 and January 1995 documented between 550 and 750 *Macrotus* roosting in the mine. Both males and females were captured in mist nets set near the mine. In December 1993, at least 63 *Macrotus* emerged from an adit in the wash below the War Eagle #1, and more could be seen coming out of a shaft above this adit. An hour after the bats had exited from the War Eagle #1, we entered the shaft. Large areas of the warm humid mine were carpeted with *Macrotus* and *Myotis velifer* guano. A torpid *Corynorhinus* was seen near the entrance where temperatures were cooler. In the summer, this shaft is a maternity colony of over 700 *Corynorhinus* and *Myotis velifer*. Exact counts of each species were not possible because of the constant circling of the bats in maternity roosts. Several interconnected adits and stopes in the canyon opposite from the War Eagle house *Macrotus* maternity colonies of several hundred bats.

2) Great Central: These 10 west-facing adits are northeast of the War Eagle, and contain maternity colonies of *Macrotus* ranging in size from 10 to several hundred. In addition two colonies of *Myotis velifer* number over 300 bats. At times, *Macrotus* also use mines in this complex in the winter, as during the 1972 and 1992 surveys.

3) Argus: The farthest east mine complex with at least 5 entrances houses a maternity colony of over 900 *Macrotus*. A 25 m long adit on the north side of the hill is a courtship or "lek" area, with bats using it only in the fall mating season.

4) "Mineral Wash": Located west of Planet (and east of Mineral Wash), this complex of about 5 openings is used by *Macrotus* during the maternity season and as a major "lek" area in the fall.

Rankin Ranch area:

1) West Rankin: This adit contains over 1000 male and female *Myotis velifer* during the maternity season, as well as male *Macrotus*. In the winter about 780 *Macrotus* of both species use this adit.

2) East Rankin shaft and adit: The adit above the shaft contained a maternity colony of over 100 *Myotis velifer*, while the shaft had several hundred more, as well as male *Macrotus*. In the winter, only a few *Macrotus* were observed here.

Swansea Wilderness Area

1) Connecting shaft and adit NE of Swansea Wash on north side of BWR: Maternity colony of *Corynorhinus* and *Macrotus* of over 750 bats in the spring and a winter colony of 250 *Macrotus*.

Rawhide Wilderness Area

1) Mildred: An adit with an internal winze contained approximately 100 *Macrotus* during the winter. Other mines in or near the Rawhide Wilderness Area that contained guano, but no bats during the winter survey included the Clayton, Diana May and North January.

Mist-netting

During 160 net/hours, 794 bats of 13 species were captured (Table 2), the majority in the first two hours of the night. Reproductive females or juveniles were captured for all species, with the exception of *Lasiurus xanthinus* and *cinereus*, and *Eumops* (which escaped from the net before any determination could be made). In addition to mist-netting over water on the BWR and the Planet Ranch swimming pool, nets were set near the entrances of the Rankin Mine shaft and the War Eagle Mine shaft to monitor sex and/or reproductive condition of the bats.

Radio-telemetry

Three *Lasiurus xanthinus* and 2 *Lasiurus cinereus* that were captured in mist nets over the BWR or the Planet Ranch swimming pool were fitted with transmitters and tracked to diurnal roosts. These roosts are shown on the attached map. One yellow bat promptly left the area and was not heard from again, even with the aid of airplane flights. Another left the BWR and was picked up from an airplane over Lake Havasu City. Tracking on the ground pinpointed his location in tall palms in the front yard of a house one mile NE of London Bridge. The next day he was gone from there, with no forwarding address. The third yellow bat, roosted in a cottonwood tree foliage at the Planet Ranch the day after his capture in July. The next evening he headed down river and was not detected for two nights. The third night he was detected around midnight roosting in a tree about 3 miles upstream from the mouth of the BWR. He was gone from there the next morning, but located (by plane) in a grove of palm trees below the Gene Pumping Station in California. Three days later, when a AGFD biologist checked there, the bat was gone.

The hoary bats were more sedentary. One bat continued to forage over the BWR in the vicinity of his capture (on the eastern boundary of the Bill Williams National Wildlife Refuge), and day roosted in the same dense cluster of willow leaves 20 feet above the ground on the north side of the river. He was recaptured in this spot after 3 nights and the transmitter removed. The other hoary bat roosted the first day after his capture in a willow tree in the BWNWR about half a mile west of his capture point, and then for two days he was located during the day in a palo verde tree about a half mile from the mouth of Mineral Wash. He vanished before his transmitter could be removed.

Sonar Signals

Bats were recorded via the Anabat at most netting sites, but analysis as to species was not possible for most. *Tadarida* emits a very characteristic search phase call that was detected in many locations most evenings, even occasionally during the winter. *Nyctinomops* also emits a characteristic audible "squabble", especially near roosts. This was heard near the cliffs on the north side of the BWR upstream of the Planet Ranch. The human audible *Eumops* signals were heard over Lincoln Ranch and Planet Ranch during all seasons except winter. None of the signals were detected right after dark, which would have been an indication of a roost in the immediate vicinity.

DISCUSSION

The Bill Williams River supports a rich and varied bat fauna. Most of the species detected during the present survey might have been deduced from current range maps, with the exception of yellow bats, western mastiff bats and pocketed free-tailed bats. Yellow bats are closely associated with palm oasis in the Sonoran and Colorado deserts. Recent records from Phoenix and the Los Angeles Basin suggest that their range may be expanding with the planting of ornamental palms. The palms at Lake Havasu City are a normal roost tree for a bat now beyond its "normal" range. However, during the radio-telemetry study, the yellow bats were also found to use the native vegetation of the BWR (cottonwoods and willows), and may have seasonally also occupied this area, but remained undetected until now.

Western mastiff bats have recently been captured by AGFD biologists in northern Arizona, so their presence along the BWR is not surprising, even though a specimen had not been previously taken there. The cliff faces preferred as roosting habitat are in abundance. The same is true for *Nyctinomops*. At the onset of this survey, it had been hoped that the cliff faces along the BWR might also shelter spotted bats (*Euderma maculatum*), but they were not seen, heard or netted. Spotted bats have recently been captured and telemetered by AGFD biologists at higher elevations along the North Rim of the Grand Canyon. In spite of many hours of mist-netting, no *Leptonycteris* were captured along the BWR. Possibly the bat retrieved from the swimming pool at Planet Ranch and so accurately described by the staff and family, may have been a vagrant. A study to "stake out" flowering saquaros might yield future results, although no evidence of this species' distinctive guano was found in any mines surveyed.

The mines near Planet Ranch along the Bill Williams River shelter a sizable population of *Macrotus*. Many of these mines are located on private land, with

the remainder managed by BLM. An estimated 900 or more bats now spend the winter in the War Eagle mine complex, with an equal number in a maternity colony in the Argus Mine. When other mines are taken into account, the total population of bats in this area is probably over 2,000. Since in 1972 and 1992, roosts of over 100 bats were seen in adits where they were not found on this survey, *Macrotus* may change roosts in response to disturbance or unknown environmental variables. The large quantities of guano found in some workings (notably the adits west of Planet, the Argus and the Great Central) suggests several large maternity colonies or a large maternity colony that moves. Most of these workings share the characteristic of large rooms close to the surface with multiple entrances. These attributes are consistent with the configurations of mines found in California that are currently used as maternity roosts. The temperatures in the summer in the areas of the mines that the bats occupy usually exceed 85 F. In contrast, the areas in mines chosen for winter roosts are generally several hundred feet deep in mines in areas with no air circulation where temperatures may exceed 80 F. Often the bats used domed chambers or raises that trap warm air. Since the mines are warmer than the annual mean temperature, they appear to be geo-thermally heated. The large number of mines with suitable roosting configurations and temperatures near Planet combined with nearby riparian foraging habitat may account for the large population of this species in this area.

A previously undocumented behavioral use of mine roosts occurred during this survey when a short adit with large guano deposits was found to be a *Macrotus* lek site—an area not occupied except during the courtship period in the fall. No bats have been found here day or night at other seasons, but during September and October, male bats entered this mine after dusk from nearby diurnal retreats to establish calling areas in the mines. The females stopped by an hour or two later (after presumably foraging) to select a mate. We have found three mines in the Planet area with large numbers of displaying bats—in some, courtship activity continues around the clock.

Two other sensitive species were also found using the mines. In the winter, isolated torpid *Corynorhinus* were discovered in the War Eagle shaft (in addition to a shallow sandstone cave). The bats chose areas where cold air would drain. A subsequent visit in May to the War Eagle, showed that the shaft is a *Corynorhinus* and a *Myotis velifer* maternity roost. The use of this mine in the winter by large numbers of *Corynorhinus* makes this mine especially critical. Evidence from subsequent visits suggests that human visitation to this mine and others in the area is increasing and protective measures should be initiated.

MANAGEMENT RECOMMENDATIONS

1. Install bat gates on the important mine roosts for *Macrotus*, especially those accessible and/or visited by humans. In the Planet area these include: the War Eagle shaft, Argus adits, "Mineral Wash" and Great Central adits. In particular, the War Eagle is a locality for mineral collectors. All except the "Mineral Wash" adits in the Planet area are located on private land, and as such the BLM would not have authority to install bat gates, although the AGFD could work with the owners on cooperative protective measures. The "Mineral Wash" adits could be gated by BLM. Protection of roosts on public lands could become an important issue if renewed mining were to occur in the future on the adjacent private claims, and the bats were forced to relocate. Several important bat mine roosts

on BLM land (Swansea and Rawhide Wilderness areas and north of the Rankin Ranch) are at this time relatively inaccessible to humans due to restrictions to vehicular traffic. The Rankin Ranch area mines could receive more visitation in the future if road access across the BWR were restored. At that time, gating the Rankin mines may be warranted.

2. If mines area gated, their success should be monitored over time by counting bats exiting at different seasons. Exit counts should also be conducted at non-gated bat roosts in the vicinity at the same time with standardized protocol. A control for natural fluctuations would be the continuous monitoring of a vary remote site, such as the *Macrotus* and *Corynorhinus* mine in the Swansea Wilderness area. Some *Myotis* species (such as grey bats) do not tolerate gates at maternity sites. Gated *Myotis velifer* maternity roosts should be closely monitored.