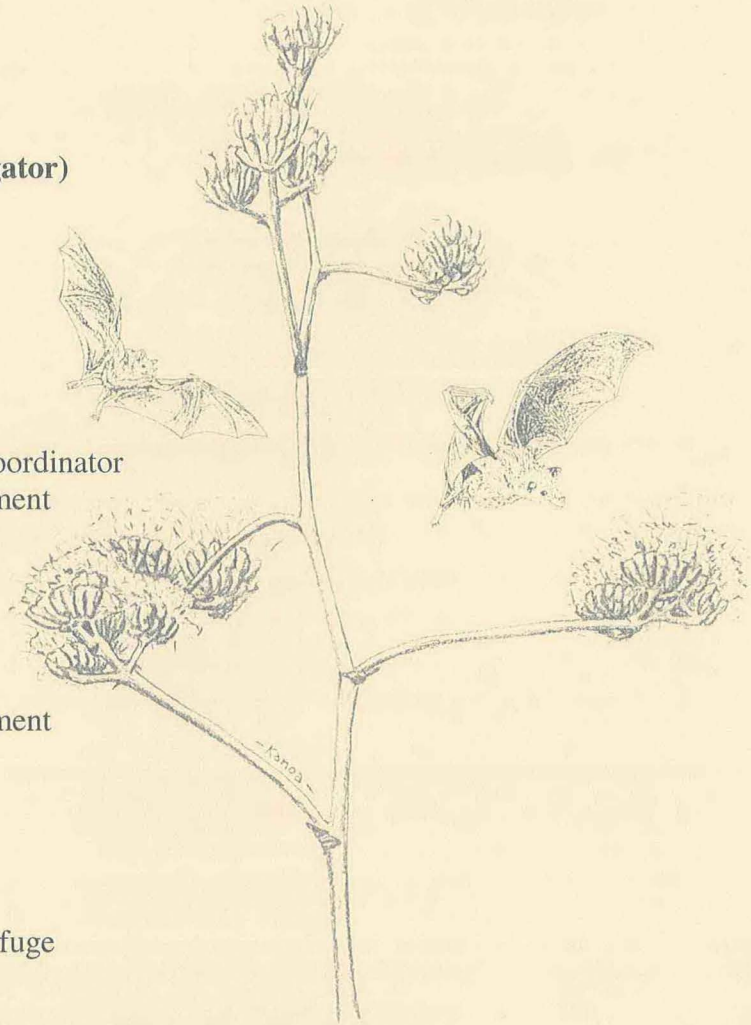
UNDERSTANDING THE FALL MIGRATION OF THE ENDANGERED LESSER LONG-NOSED BAT (*LEPTONYCTERIS CURASOAE*) AN EXTENSION OF THE ARIZONA-SONORA DESERT MUSEUM'S MIGRATORY POLLINATOR PROGRAM
(Two-Year Project)

Final Report for 2004-2005 Study



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March 2006

Prepared for: The National Park Service, The Arizona Game & Fish Department, The U.S. Fish & Wildlife Service, and The Arizona-Sonora Desert Museum

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First Year Final Report for 2004

Second Year (2005) Final Report

Appendix (Meeting Notes, Letters, Progress Reports, Captive Project Notes, Schedule, and Pit Tagging Protocol for 2004-2005 Project)

Note – I have combined both the 2004 and 2005 reports and provided miscellaneous documents for the two-year project "Understanding the Fall Migration of the Endangered Lesser Long-Nosed Bat (*Leptonycteris curasoae)* An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinator Program (Two-Year Project)" in one bound report. I have intentionally left out (or blacked-out) all GPS coordinates and similar information in the two reports for the endangered (*Leptonycteris curasoae)* and non-endangered *(Macrotus californicus)* bats to protect roosts and foraging habitats. I have however, provided this information to the permit agencies requesting the sensitive information for this project. I want to thank Kim Duffek for the use of her lesser long-nosed bat drawing for the front cover of this report.

I sincerely want to thank everyone involved with this important two-year project. The data that we obtained from this study provides another piece of the puzzle on migration and movements for the endangered lesser long-nosed bat within Arizona.

Karen Krebbs
Arizona-Sonora Desert Museum
March 2006

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Understanding the Fall Migration of the Endangered Lesser Long-Nosed Bat (*Leptonycteris curasoae*) An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinator Program
(2-year project)

First Year Final Report for 2004

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***Leptonycteris curasoae* in hand at the Copper Mountain roost.**

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GPS Coordinate Information

I have intentionally "blacked-out" the GPS coordinates and similar information for this report to protect the endangered (*Leptonycteris curasoae)* and non-endangered (*Macrotus californicus)* bat to protect roosts and foraging habitat. I have however, provided this information to the permit granting agencies requesting the sensitive information for this project.

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EXECUTIVE SUMMARY

In July and August 2004, we tested several markers on *Leptonycteris curasoae* at a maternity roost in southwestern Arizona and attempted to follow the marked bats to other roosts and to the southeastern part of the state. We had tested five markers earlier in the year on 10 captive *Macrotus californicus.* Our objectives in this study were to: 1) test different marking techniques on captive *M. californicus*: bat necklaces with reflective tape and bands, micro-chips (passive integrated transponder tags) with reflective tape, wrist bands, fluorescent powder and then utilize the best marker(s) on *L. curasoae*, 2) obtain information on the movements of *L. curasoae* in Arizona from their maternity roosts to roosts in southeastern Arizona, 3) determine if the bats were moving from one roost to another and obtain information on timing of the bats' movements, and 4) collect DNA from *L. curasoae* at the maternity roost where the bats were marked. Test the feasibility of using cheek swabs as a method for collecting DNA.

We accomplished all of our objectives with the exception of one. We were not able to determine if bats were moving from one roost to another in southwestern Arizona. The captive studies with *M. californicus* indicated that the micro-chip (PIT Tag) with reflective tape caused the least problems and was the best marker that we tested to utilize for the fieldwork with the *L. curasoae.* The micro-chips with reflective tape were glued on the backs of 60 *L. curasoae* in July, 2004 at the Copper Mountain maternity roost. Eleven additional bats were fitted with radio transmitters and DNA collected from all the bats (71) with micro-chips and radio transmitters. DNA was collected from an additional bat for a total of 72 bats (as per Federal permit). DNA samples were turned over to Dr. Melanie Culver at the University of Arizona. Monitoring for marked bats was carried out in July and August at three maternity roosts (Copper Mountain, Bluebird Mine, Pinacate Cave) in southwestern Arizona and northern Mexico. In southeastern Arizona, roost checks were made at the State of Texas Mine (Huachuca Mountains), Patagonia Cave (Patagonia Mountains), Pyeatt Cave (Huachuca Mountains), and various other locations in the Chiricahua, Patagonia, and Huachuca Mountains. Radio telemetry equipment, video cameras with IR lights, night-vision goggles, and a micro-chip reader/antenna were utilized outside of roosts to search for marked bats. Micro-chips with reflective tape could be detected with the night-vision goggles, video cameras, and light. The micro-chip reader and antenna did not record any of the marked bats.

On August 10, 2004, a bat was detected with the radio telemetry equipment west of the Patagonia Cave. The radio pulses were heard two different times during the evening. This bat appeared to be flying in the west and away from the Patagonia Cave. Attempts to locate the bat the following evenings failed. This adult female bat was marked with the radio transmitter on July 20, 2004 at the Copper Mountain roost in Organ Pipe Cactus National Monument (ORPI). The female was tracked with the radio telemetry equipment up to July 29, 2004 at ORPI near the Copper Mountain maternity roost. After July 29th, the bat could not be located in the ORPI area. The Patagonia Mountains are located about 211 kilometers southeast of ORPI. This is the first evidence that a *L. curasoae* has migrated from southwest Arizona to the southeastern corner of the state and may indicate that this species is moving between the coastal and inland corridors.

The Copper Mountain bat netting provided important information on both adult females and young of the year. Adult females fitted with radio transmitters were tracked at

ORPI for almost two weeks after marking. During a netting session two weeks after the marking of the bats, the only bats caught in the net were young of the year. It appeared at this time, that the majority of the bats remaining at the maternity roost were young of the year (from netting) and the adult females had moved to other areas (radio telemetry). The telemetry work at ORPI produced information about bat movements and possible timing of movements of the adult females from the maternity roost. We also obtained data on volant young of the year from our netting sessions.

ACKNOWLEDGEMENTS

This project was funded by the National Park Service (NPS), Arizona Game and Fish Department (AZGFD), American Zoo and Aquarium Association Bat Taxon Advisory Group (AZA Bat TAG), and the Arizona-Sonora Desert Museum (ASDM). National Park Service employees Barbara Alberti (Coronado National Memorial), Larry Norris (Southwest Research Coordinator), and Tim Tibbitts (Endangered Species Coordinator) provided contacts, guidance, and support for the project. Angie McIntire (AZGFD Bat Project Coordinator) also supported the project with help for permits, funding, direction, and advice. Permitting agencies or organizations included the NPS, AZGFD, USFWS, U.S. Forest Service, State Parks, AZA, United States Department of Agriculture (USDA), and ASDM provided the permits necessary for the first year of the project. Agency biologists and employees Barbara Alberti, Tim Tibbitts, Ami Pate, Sherry Mann, Larry Norris, Bonnie Stolp, Angie McIntire, Tim Snow, Mike Coffeen, Lyle Lewis, Warren Striplin, Curt McCasland, Gary Helbing, Debbie Sebesta, and Tom Deecken provided help, input, and guidance throughout the project duration. Dr. Melanie Culver provided the swabs for DNA collection, instructions for collecting, and analyzed the samples.

Tim Tibbitts, Ami Pate, Barbara Alberti, Sherry Mann, Antje Adams, Robert Graf, Anne Graf, and Eugenio Larius helped with the fieldwork and radio telemetry. Ami Pate provided information, tables, and maps for the telemetry work at ORPI. Tim Tibbitts provided the graph and text of bat abundance at the maternity roost for 1999 to 2004. Both Tim and Ami enthusiastically helped in the field at ORPI despite their normal work routine and responsibilities. Dr. Ronnie Sidner helped with the initial captive work at ASDM and her involvement was appreciated. Ronnie also looked for marked bats at the Pyeatt Cave in August. The Arizona-Sonora Desert Museum hurried the paperwork through the AZA and United States Department of Agriculture (USDA) systems for the captive research project. Yajaira Gray helped with the captive care of the *Macrotis californicus* while at ASDM. I appreciate the help of Tim Tibbitts, Ami Pate, Barbara Alberti, Sherry Mann, Curt McCasland, Eugenio Larius, Robert Graf, and Anne Graf at the roosts in both Arizona and northern Mexico. Dr. Rodrigo Medellin's support for the entire project, input on the marking of *L. curasoae,* and the work in Mexico was appreciated. ASDM Curators Craig Ivanyi and Shawnee Riplog-Peterson provided holding space and cages for the captive study with the *Macrotus californicus.*

Tani Hubbard helped with the proposal, funding problems and questions, and helped edit the final report. Her input and help was greatly appreciated. Dale and Pat Young helped with the scanning of slides/pictures, downloaded digital images of the fieldwork, and generously loaned their digital camera for the fieldwork. Laurence Fahrney helped with computer problems and assistance. Laurence also suggested that we make the report available on the web site for all

agency employees. I want to thank the companies and their employees Biomark (Audrey Callagher), Holohil Systems Ltd. (Fred Anderka), Avinet Inc., Sony, 3M Manufacturing Company, Ball-Chain Manufacturing Company Inc., for their assistance and advice. Greg Crooks helped with all the ordering and information requests. Dr. Virginia Dalton provided some of the markers we tested on the captive bats and input on the marking. Barbara Terkanian helped edit the report. Pictures are the property of Karen Krebbs.

Several years ago, Dr. Yar Petryszyn and I came up with the idea of testing to see if *L. curasoae* were moving from southwestern Arizona to the southeastern corner of the state. I appreciate Yar's input, suggestions, and conversations for this project. I also appreciate conversations with Dr. Ronnie Sidner, Dr. Virginia Dalton, Dr. Rodrigo Medellin, Dr. Richard Brusca, Dr. Patricia Brown, Dr. Melanie Culver, Angie McIntire, Kim Duffek, Warren Stripland, and John Turner. Dr. Melanie Culver provided material for the DNA cheek swabs.

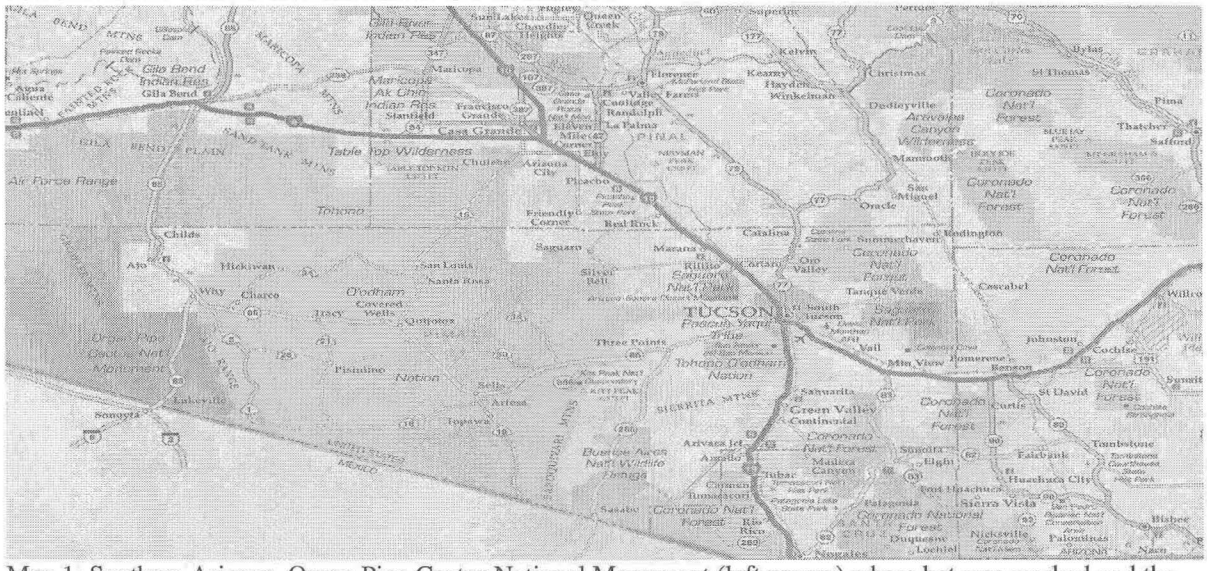
INTRODUCTION

The lesser long-nosed bat (*Leptonycteris curasoae)* is a federally listed (endangered) species in both the United States and Mexico (Cockrum and Petryszyn 1991). Relatively few species of bats undergo long distance migrations. More than one hundred thousand female lesser long-nosed bats migrate into northern Sonora, Mexico and southern Arizona each spring to establish maternity colonies and give birth to their young (Fleming and Eby 2003). Lesser long-nosed bats depend upon columnar cactus during their northern migration and agaves, tropical trees, and shrubs when they migrate south for the winter. These migratory corridors, or "nectar corridors" consist of a series of stepping stones, or patches of flowering plants, that provide nectar for refueling during migration along 2000-6000 km flyways (Nabhan and Brusca 2002). After migrating north, females give birth to a single pup in northern maternity roosts like Copper Mountain and the Pinacate roosts. After the young are weaned, it is not clear if the mothers and young in the southwestern part of Arizona move back down to Mexico in late summer or travel to the southeast corner of the state to utilize the rich agave nectar. Usually when large numbers of *L. curasoae* appear in southeastern Arizona, the maternity colonies in southwestern Arizona and northern Mexico show a complementary decrease in numbers of bats (Tibbitts, McCasland, and Alberti pers. comm.).

The late summer departure of bats from their maternity roosts is correlated with declining resource levels and perhaps weather/climate conditions (Nabhan and Brusca 2002). Research conducted by the Arizona-Sonora Desert Museum (ASDM) and Dr. Theodore Fleming for the Migratory Pollinator Program in the late 1990's indicated that *L. curasoae* are using two different migration paths (corridors) to reach northern Sonora and southern Arizona. Fleming (Data from the Migratory Pollinator Program) reports that migrating females are more likely to move within a corridor than between corridors (Nabhan and Brusca 2002). Whether *L. curasoae* are moving between corridors (i.e.- from southwest Arizona to southeast Arizona) after the young are volant or moving directly south into Mexico has never been tested. This project tested different marking techniques, observed movements of this species within Arizona, investigated possible departure points for the southward fall migration to Mexico, and collected DNA at a maternity roost in southwestern Arizona. We also obtained data on *L. curasoae* during the

netting at Copper Mountain that indicated the physical conditions of adult females after weaning of the young (Table 2, 3, 4, 5).

Making empirical observations of individuals that may switch corridors required that we use semi-permanent, visible markers such as reflective tape on wing bands (Kunz 1996), or on necklaces (Handley et al. 1991, Isaac et al. 2003), passive integrated transponders tags (O'Shea et al. 2003), fluorescent powder (Kunz 1996), or radio transmitters (Ober et al. 2000, Neubaum et al. 2003) to confirm if individuals are using or switching migratory corridors. Several different marking techniques were first tested on a captive population of *M. californicus* at the ASDM. In April 2004, ten *M. californicus* were collected at a roost in the Tucson Mountains (Table 1). These bats were kept in captivity for eight weeks and four different markers (bat necklaces with reflective tape, micro-chips with reflective tape, wrist bands, fluorescent powder) were placed on the bats for testing. From our captive study, we concluded that micro-chips with reflective tape was the best marker we had tested to utilize on *L. curasoae* in the field. We also utilized radio telemetry, a commonly used technique to follow bats locally, to follow the bats in Arizona (southeast and southwest) and northern Mexico. In the field we glued micro-chips (with reflective tape) on the backs of 60 *L. curasoae* and radio transmitters on 11 bats (Table 2, 3, 4). We searched for the 71 marked bats at roosts in southwestern and southeastern Arizona and northern Mexico. One of the marked bats was located in the mountains of Patagonia (Table 7) with the radio telemetry. This is the first evidence that *L. curasoae* is moving between migratory corridors in Arizona. Studies in the future can indicate if more bats are moving from the southwestern corner of Arizona to the southeast.



Map 1: Southern Arizona. Organ Pipe Cactus National Monument (left corner) where bat was marked and the Patagonia Mountains (right of I-19 and road 82 and between Green Valley and Nogales) where marked bat was detected 21 days after originally marked.

OBJECTIVES

1) Test different marking techniques on captive *M. californicus*: bat necklaces with reflective tape, micro-chips (passive integrated transponder tags) with reflective tape, wrist bands with reflective tape, fluorescent powder, and then utilize the best marker(s) on *L. curasoae.*
2) Obtain information on the movements of *L. curasoae* in Arizona from their maternity

roosts to roosts in southeastern Arizona.

3) Determine if the bats are moving from one roost to another and obtain information on timing of the bats' movements or departures from the roost.

4) Collect DNA from *L. curasoae* at the maternity roost where the bats were marked. Test the feasibility of using cheek swabs as a method for collecting DNA instead of the standard wing punches.

METHODS

We conducted the captive study at the ASDM in April and May 2004 with the *M. californicus.* The fieldwork with *L. curasoae* was carried out in July and August 2004 at ORPI in southwestern Arizona and in the mountains of southeastern Arizona (Chiricahua, Huachuca, Patagonia).

Captive Study

A collecting trip was made on April 7, 2004 to obtain *M. californicus* for the captive part of the bat-marking project for *L. curasoae* (Table 1). The bats were caught outside the roost with three mist nets (2-2.4 meter, 1-6 meter) set up 6 meters from the roost. We collected ten bats at the "Mission Bat Mine" roost in the Tucson Mountains and transported the bats to ASDM for holding. The bats were collected and held at ASDM with an AZGFD permit, ASDM Research License, and USDA permission. The bats were held in captivity at ASDM for eight weeks and different marking techniques were tested on the bats. Marking techniques used on the captive bats included necklaces with reflective tape, micro-chips (with reflective tape) glued to the backs of the bats, reflective tape alone, wristbands (with reflective tape), and fluorescent powder. DNA (cheek swabs) was collected from all 10 bats. Five of the bats were returned to the roost and released on April 27 and May 6, 2004 (Table 1). Four of the bats were released at the roost with necklaces and one bat with fluorescent powder. Five bats remain at ASDM under an AZGFD Collecting/Holding Permit for a planned future exhibit. Three of the captive bats still have necklaces and the bats and necklaces are being monitored for potential problems. Six additional visits (April 27, May 6, May 29, June 20, July 16, September 22) were made to the roost to look for marked bats (Table 1).

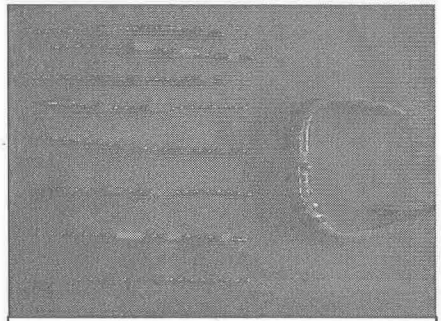


Figure 1: Necklaces with bands and reflective tape.

Necklaces consisted of aluminum ball, chain, and connectors (Ball-Chain Manufacturing Co., Inc.) with reflective tape (3M Manufacturing Co.) glued to the connectors and plastic butt-end bands (Avinet, Inc.) attached to the chain. All 10 bats were fitted with necklaces that had reflective tape and bands attached to them. Three colors of reflective tape (red, yellow, gray) were used for the necklaces.

The necklace (without the band and reflective tape) weighed .50 g and the band with reflective tape weighed .11 g. The total weight of the necklace, band, and reflective tape was .61

g. The space between the necklace and the bat's neck ranged from 8.0 to 9.0 mm. We wanted a necklace that would stay on the bat's neck but would also allow for growth or weight gain.

Lamborn lipped bands were put on the wrists of five of the bats. Red and yellow reflective tape was glued to the wristbands. Super glue was used to adhere the reflective tape to the bands and ball chain connectors. The weight of the wristbands and reflective tape was .11 g. Fluorescent powder (Radiant colors-yellow) was applied to the back (dorsum) and the belly (venter) on two of the bats.

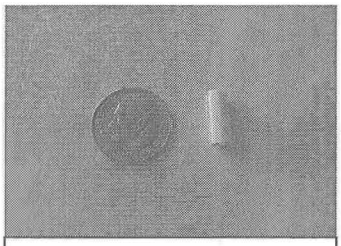


Figure 2: Coin and micro-chip with reflective tape.

A micro-chip (PIT Tag) with reflective tape (yellow color) was glued to the back of three bats. The weights of the micro-chips ranged from .07 to .10 g. Skinbond surgical adhesive was used to glue the micro-chips to the back of the bats. Hair was trimmed on the back of the bats for the application of the skinbond surgical adhesive for the micro-chips (with reflective tape).

Reflective tape was also glued to the backs of two bats and the hair trimmed to help the glue adhere better.

DNA was collected using cheek swabs. We wanted to test the feasibility of using cheek swabs instead of the standard wing punches usually used for DNA collection. We felt the cheek swab technique would be less invasive than the wing punches. Cheek swabs were inserted in the mouths of the bats or under the lip to collect the DNA. The swab was then placed in a small vial and preserved with alcohol. All DNA samples were turned over to Dr. Melanie Culver for analysis at the University of Arizona.

Bats were allowed to fly within the holding room at ASDM during trials to test the visibility of markers. The bats were observed with night-vision goggles, filmed with video cameras and IR lights (IRM Sony lights), and bright lights (powerful flash lights). During these trials, the room remained dark and bats were observed from different angles and heights.

The five bats that were released at the roost were observed and monitored on six different occasions. After release, the bats were observed with night-vision goggles, video cameras with IR lights (IRM Sony lights), and bright lights and all observations took place at night. The "Mission Bat Mine" is gated and the roost was never entered. Several times the observers looked for marked bats inside the roost by sitting at the entrance of the roost and looked inside with the night-vision goggles. These observations were made at dusk and before the bats started exiting the roost.



Figure 3: Bat biologists Ami, Karen, and Tim at ORPI.

Fieldwork – Southwestern Arizona/Northern Mexico

Copper Mountain Maternity Roost – Copper Mountain is a maternity roost used by female *L. curasoae* in late spring each year. The females migrate to southwestern Arizona in late spring from southern Mexico.

The females give birth to their single pup in May and June of each year (Tibbitts pers. comm.). The mine consists of

a single horizontal tunnel, open at both ends, that is 254-m long, 2-m high, and 1.5-m wide (Fleming et al. 1998).

A total of 118 *L. curasoae* were netted at the Copper Mountain roost at ORPI in July and August 2004 (Table 2, 3, 4, 5). Our USFWS permit allowed us to mark a total of 72 bats with radio transmitters (12 bats) and micro-chips (60 bats). Seventy-one bats were marked at the Copper Mountain roost on July 19, 20, and 21, 2004 (Table 2, 3, 4). Sixty bats were marked with micro-chips with reflective tape (red or yellow) and 11 bats marked with radio transmitters (Table 2, 3, 4). One of our radio transmitters did not work so we were unable to mark 12 bats with transmitters as we had planned. All markers were glued to the back of the bats with skinbond surgical adhesive. Radio transmitters were used exclusively on adult female *L. curasoae* (Table 2, 3). The weights for the 11 females (Table 2 and 3) ranged from 21 grams to 26 grams (average weight was 23.1 grams). The radio transmitter weighed 0.52 grams. The weight of the radio transmitter to adult female bat body mass ratio ranged from 3.0 to 3.8 %. Forty-nine micro-chips were placed on juveniles (male and female) and on 11 adult females. The micro-chip with reflective tape weighed 0.11 grams or less. The weights for the 49 juveniles (Table 2, 3, 4) ranged from 19 grams to 27 grams (average weight was 22.0 grams). The weight of the micro-chip with reflective tape to juvenile bat body mass ratio ranged from .41 to .57 %. The weights for the 11 adult females (Table 2, 3, 4) ranged from 22 to 29 grams (average weight was 24.2 grams). The weight of the micro-chip with reflective tape to adult female bat body mass ratio ranged from 0.38 to 0.50 %. All markers placed on the backs of adult females and juveniles were well under the recommended 5 % of the body mass of the bat. We recorded GPS coordinates for all of the netting sites.

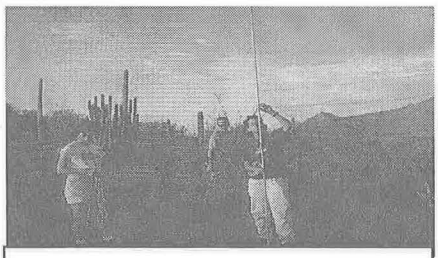


Figure 4: Biologists Karen, Tim, & Ami putting up the net at ORPI.

During the netting on July 19-21 2004, three nets were set up each evening. We used 2.4 m, 6 m, and 9 m nets to catch the bats (Table 2, 3, 4). All nets were set up outside the south exit of the Copper Mountain roost and from 30 m to 61 m from the roost. We carefully chose distances and areas from the roost so we could avoid capturing too many bats at one time.

During the netting, we continuously monitored nets, immediately removed bats, and closed nets appropriately to avoid having to handle excessive number of bats. Bats were handled and marked by experienced biologists (Karen Krebbs, Tim Tibbitts, Ami Pate).

Captive bats were placed in individual cloth bags, in order to minimize their movements and prevent injury. Data (Table 2, 3, 4) were recorded on age, sex, general body condition and body mass, and bats were then marked (radio transmitters, micro-chips with reflective tape).

DNA cheek samples were taken from 72 bats (as per USFWS permit).

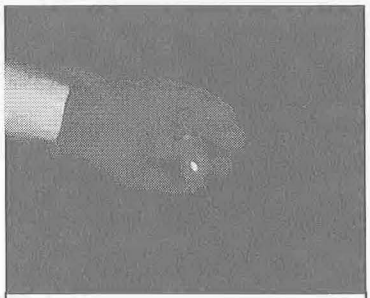


Figure 5: Releasing *L. curasoae* with micro-chip and reflective tape.

On August 3, 2004 we set up one-six meter net at the south exit of the Copper Mountain roost for an Arizona Daily Star interview with Mitch Tobin. The net was open for one hour and then closed for the evening (Table 5).

We collected genetic samples from 72 *L. curasoae* during the marking sessions at the Copper Mountain roost (Table 2, 3, 4). The DNA was collected in the form of mouth (buccal) swabs. The swab was rubbed on the inside of the bats' mouth to collect the DNA. The bats often licked and bit at the swab, unlike the captive *M. californicus*. The swab was then placed in a sterile alcohol container. The mouth swabs were turned over to Dr. Melanie Culver at the University of Arizona for DNA extraction and sequencing.

After attaching markers, we checked exit flights of bats at Copper Mountain and the Bluebird Mine to watch for reflective markers (Table 6). The micro-chip reader and antenna (Table 6) were set up outside the north and south exits for Copper Mountain and the fence). A trip was made to the Pinacate roost to look for marked bats and the radio telemetry equipment, video cameras with IR lights, and micro-chip reader and antenna were utilized to search for marked bats (Table 6).

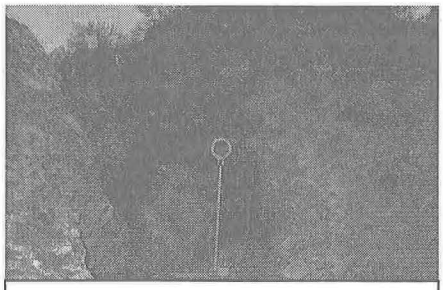


Figure 6: Micro-chip reader and antenna at exit of Copper Mtn.

Radio telemetry equipment was set up at ORPI on a nightly basis to follow marked bats (Table 6, 8). During this time the roost was monitored for marked bats with the night-vision goggles, video cameras with IR lights, and micro-chip reader and antenna. GPS coordinates were taken for every roost check (Table 6).

Radio telemetry field data collection - Eleven .52 g Holohil BD-2 transmitters were attached with Skinbond adhesive on July 19 and July 20. The bats were released as soon as the adhesive was dry. Transmitters were attached to seven adult post-lactating females (average weight 23 grams), three were attached to juvenile males (average weight 23 grams), and one attached to a juvenile female (23 grams). Signals were tracked with 5-element Yagi directional antennas mounted on a 2 m aluminum pole. The free-turning pole, with Silva compass attached for recording bearing data, was anchored with a Bogen tripod, or PVC tube in rock cairn. Communication Specialists, Inc. R-1000 radios were used to receive signals.

An observer at the south end of Copper Mountain checked for signals intermittently on July 19 and 20 while radio tagging and other project work was occurring. A single observer tracked from Copper Mountain peak on July 22, 23, 29 and August 2 (and August 3 from an alternate location) while roost exit flights were videotaped, to determine signal presence or absence and general direction of bat activity. Two nights of coordinated multi-station bat tracking were accomplished on July 27 and 28, approximately one week after transmitters were first attached. On those two nights, three hilltop telemetry stations were located northeast, southwest and southeast of the Copper Mountain roost area, and one station was located on Copper Mountain peak. Observers were in communication by two-way radio to coordinate tracking efforts, and collected bearing data every minute, using synchronized watches.

Data analysis - Signal bearing data was entered into Excel spreadsheets. Data from a single observer with no cross-bearing information from other trackers was summarized as to time of detection and general direction from tracking station. Signal bearing data from two or more observers was analyzed using LOAS 3.0.2 (Locate a Signal, Ecological Software Solutions). Bat locations were estimated with the "maximum likelihood estimator" model, which calculates error ellipses as well as most likely geographic point. Multiple bearings for one frequency with no crossings were not used in the analysis. Results from the calculations were exported to .shp files and used with ArcMap 9 to display time and point locations for each frequency (Map 2, 3, 4, 5, 6, 7).

Fieldwork – Southeastern Arizona

We began looking for bats in southeastern Arizona in August. We checked roosts in the Patagonia (Patagonia Cave) and Huachuca Mountains (State of Texas Mine, Pyeatt Cave {Sidner}) and utilized radio telemetry equipment in the Chiricahua, Patagonia, and Huachuca Mountains (Table 6). National Park Service biologists continued their searches for marked bats at ORPI while the southeastern mountains were monitored for marked bats. At the Patagonia Cave, State of Texas Mine, and the Pyeatt Cave (Sidner), we utilized equipment (radio telemetry, video cameras with IR lights, micro-chip reader and antenna, night-vision goggles) outside the roosts to search for the marked bats. Roosts and mountains were monitored for marked bats throughout the month of August (Table 6). We did not continue our searches beyond this time (August) because of the short-duration life of the glue (skinbond adhesive) used to adhere the markers to the bats.

Equipment

Equipment used for the captive study and fieldwork included Sony video camera (Model DCR-TRV350), IR lights (HVL-IRM Sony), Litton Night-Vision Goggles (Model M973), Garmin GPS 12, Radio Telemetry Unit (Holohil Systems, Ltd.), PIT TAG (Biomark, Inc.), PIT TAG Reader and Antenna (Biomark, Inc.), Kestrel Weather Instrument, Mist Nets (Avinet, Inc.), Canon Digital Camera, and Minolta 35 mm camera.

RESULTS

Captive Study

Necklaces – All 10 of the captive *M. californicus* were fitted with stainless steel chain and ball necklaces. Four of these bats either got the necklace off (by chewing) or managed to get the necklace caught in the mouth. Those necklaces caught in the mouth were cut off the bats' necks. We determined that a space of 8.0 to 9.0 mm between the necklace and the bats' necks resulted in a good fit and prevented the necklace from coming off or getting caught.



Figure 7: Captive bat with necklace.

The spacing between the neck and necklace is sufficient for growth and weight gain. Five bats remain at ASDM (for a future exhibit) and three of these bats continue to wear necklaces. There have been no problems with the necklaces on the captive bats for

more than nine months (~270 days). Some of the reflective tape on a necklace is coming loose but the other reflective tape is secure.

When the marked bats were flown within the holding room at night, the necklaces were sometimes hard to detect but could be seen in flight and while the bats hung on the walls. The necklaces were not always a reliable visual marker and the position or angle of the bat dictated whether you could see the necklace. The necklaces were observed with night-vision goggles, video cameras with IR light, and bright lights. Five of the bats were returned to the roost and four of the bats were released with necklaces. The necklaces could be detected within the roost but were harder to see outside the roost. The observer looked for marked bats within the roost by standing outside the roost gate and looked into the roost. Bats could be seen hanging on the walls of the roost. We could not see bats that were farther back in the roost. At other times the observer sat outside or above the roost (9 meters or more from the roost gate) to look for marked bats as they exited the roost.

Wristbands - Five of the captive bats were fitted with wrist Lamborn Lipped Bands. All the bats developed some type of irritation or rubbing as a result of the wristbands. All wristbands were removed from the bats' wrists within one to two weeks. The bands were removed before we could test the visibility of the reflective tape on the bands when the bats were flown within the holding room. Wristbands were not tested on *L. curasoae* in the field because of past negative results from banding in Mexico and discussions with Rodrigo Medéllin (see Discussion Section).



Figure 8: Captive bat with fluorescent powder.

Fluorescent powder - We sprinkled fluorescent powder on the back and belly of two of the bats. The powder was still visible after seven days but the bats scratched and rubbed the areas where the powder was applied. Both bats rubbed off the fur on the belly and back area where the powder was located. The fur grew back within six weeks.

The fluorescent powder could be detected in the bat guano one day after application but not in the days thereafter. The fluorescent powder could be faintly detected when the bats were flown within the dark room. The bat's position and angle were important for detecting the powder. The powder was easier to detect if the bat hung on the wall and was not flying.

Micro-chips - Micro-chips with reflective tape (yellow) were glued on the back of three bats. Two of the bats removed the micro-chips (or they fell off) by the next day but one micro-chip remained glued on the back of the third bat for 14 days. The skin bond we used was not fresh and this may have affected the time the chip remained glued to the bat.

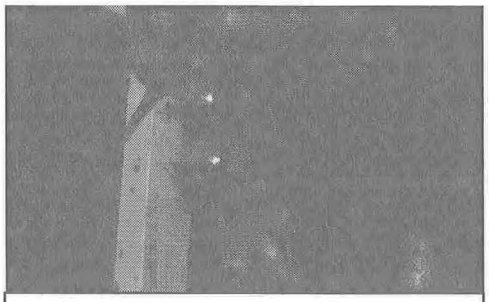


Figure 9: Bats with micro-chips & reflective tape observed in dark room.

The micro-chip was very visible during flight and could also be detected when the bat hung on the wall. When we watched

the marked bat from above, the micro-chip was very visible as you looked down upon the bat.

DNA samples – We collected DNA samples (cheek swabs) from all 10 bats. We turned the samples over to Dr. Culver (University of Arizona) for analysis. Dr. Culver was able to extract DNA from the cheek samples.

Fieldwork – Southwestern Arizona and Northern Mexico

A total of 71 bats were marked with radio transmitters (11 bats) and micro-chips with reflective tape (60 bats) in July 2004 (Table 2, 3, 4). All bats marked were captured in nets placed outside the south exit of Copper Mountain roost at ORPI. Following the marking we searched for bats at the Copper Mountain, Bluebird Mine, and Pinacate roosts. We utilized radio telemetry equipment (Table 8), video cameras with IR lights, night-vision goggles, and micro-chip reader and antenna to search for marked bats.

Of the 11 radio-tagged bats, all but 3 were detected during the radio tracking (Table 9). The radio of one of those bats was found dropped inside of Copper Mountain roost on July 26, 2004. The other bats were confirmed to be carrying their transmitters ranging 7-15 days at ORPI (Table 8, 9). Bat # 329 was last detected in the monument on July 29, 2004, and was detected in the Patagonia Mountains in southeast Arizona on August 10, 2004.



Figure 10: Tim Tibbitts setting up telemetry equipment at ORPI.

Telemetry location points for this project are estimates only, subject to errors contributed by signal bounce in mountainous terrain, the signal variability of flying bats, and minor errors in field telemetry measurements. Radio tracking stations were limited to four locations within three miles of Copper Mountain roost because of personnel and equipment constraints.

Bats were rarely tracked after 2300 hours, because they had left the range of signal detection or returned to the roost. While two of the bats (frequency 608 and 677) spent time foraging in the vicinity of Copper Mountain, the majority appeared to be flying en route to foraging areas in the Ajo Mountains. Two bats (frequency 138 and 329) were tracked in Alamo Canyon. Most of the time, bats flew south of Alamo Canyon wash along the western bajada of the Ajo range, disappearing in higher elevation terrain or near the mouth of Arch Canyon. On two occasions, bats (frequency 097, 677) flew northeast of Copper Mountain to the Grass Canyon area before flying south of Alamo Canyon wash.

Bats marked with transmitters were followed and monitored at ORPI for up to 15 days after the original marking session (Table 8, 9). After this time we could not locate marked bats at ORPI with the telemetry and felt the bats had moved to another location. We marked bats towards the end of July since many of the bats leave this maternity roost at the end of July and the first part of August (Tibbitts pers. com.). We felt timing would be crucial to maximize the battery life of the transmitters. When we could no longer locate marked bats, we then moved our efforts to the mountains of southeastern Arizona (Table 6).

Summary of radio tracking hours -

Date	Tracking Hours	Total Time	# of Observers
7-22-04	20:10 – 21:31	1 hour, 11 minutes	1
7-23-04	20:00 – 21:25	1 hour, 25 minutes	1
7-26-04	20:00 – 00:00	4 hours	4
7-27-04	20:00 – 23:00	3 hours	4
7-29-04	20:00 – 22:30	2 hours, 30 minutes	1
8-2-04	20:00 – 22:00	2 hours	1
8-3-04	20:00 – 21:30	1 hour, 30 minutes	2

The micro-chip reader and antenna, video camera with IR lights, and night-vision goggles were utilized at the Copper Mountain, Bluebird Mine, and Pinacate roosts (Table 6). The micro-chip reader did not record any of the marked bats at any of the roosts in southwestern Arizona or northern Mexico. The micro-chip antenna required that the marked bat fly within 30 to 38 centimeters (cm) of the antenna loop. Even though the bats were observed flying close to the antenna at the three roosts (mentioned above), it is not certain if they came within the required 30-38 cm for detection. The micro-chip reader/antenna makes an audible beep when a micro-chip is detected. Even though a beep was heard on several different occasions, there was no record on the reader's memory bank. Biomark can customize antennas for use with the micro-chips but time restraints prevented us from obtaining a different antenna to use for the fieldwork. The micro-chips with reflective tape could be seen with the night-vision goggles and video camera as the bats exited the Copper Mountain roost.

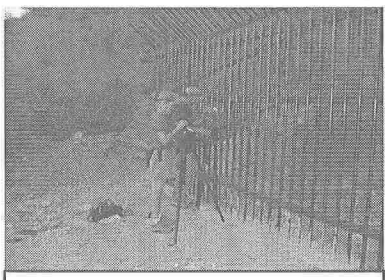


Figure 11: Karen and Curt McCasland with video cameras at Bluebird Mine.

None of our marked bats were detected at the Bluebird Mine or Pinacate roosts (Table 6). We utilized the same equipment at these roosts that we had used at the Copper Mountain roost, with the exception of the night-vision goggles at the Pinacate roost. We did not take the night-vision goggles into Mexico. We were hoping to obtain information on whether the bats were moving from one roost to another but did not do this.

Since the majority of our searches for marked bats were conducted at ORPI, we may have missed some of the bats at other roosts.

The netting session at the Copper Mountain roost worked out well and we obtained excellent biological information on both adult females and young of the year (Table 2, 3, 4, 5). We were never overwhelmed with more bats than the three bat handlers (Karen K. Tim T., Ami P.) could manage. We closed the nets several times during the evenings for the netting sessions to avoid capturing too many bats.

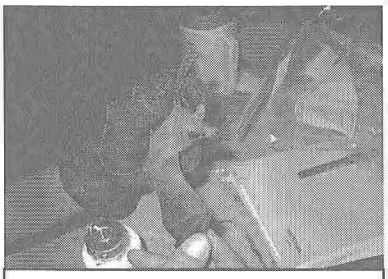


Figure 12: *L. curasoae* data collection at ORPI.

All bats flew off immediately after processing and marking. If the captured bat was not a good candidate for marking, we weighed and sexed the bat, assessed the overall physical condition, and then released the bat.

We made the decision to mark individuals based on age, weight, and general physical condition of the bat. We did not want to mark young bats (Table 5) that had just learned to fly (or leave the roost) or adult females that were still lactating. We netted very few females that were still lactating (Table 2, 3, 4). After the initial marking session, we entered the Copper Mountain roost one evening after all the bats had left and found one radio transmitter and micro-chip with reflective tape. These markers had fallen off the bats but indicated that bats had returned to the roost after being handled and marked. Our radio telemetry efforts also indicated that the marked bats returned to the roost the next evening after they had been marked



Figure 13: Collecting DNA from a young *L. curasoae* caught in net at ORPI.

Fieldwork – Southeast Arizona

We began our search for marked bats in southeast Arizona the first week of August (Table 6). We checked the State of Texas Mine, Pyeatt Cave, and the Patagonia Cave in the Huachuca and Patagonia Mountains for marked bats utilizing night-vision, video camera, micro-chip reader/antenna, and radio telemetry (Table 6). We also set up the radio telemetry equipment on hilltops in the Chiricahua and Patagonia Mountains (Table 6).

Micro-chip reader/antenna – The micro-chip reader/antenna was set up outside the roosts at the State of Texas Mine and Patagonia Cave (Table 6). At all of the roosts in southwestern Arizona and northern Mexico and the Patagonia Cave, the bats flew close to the antenna although they did not have to do this to exit the roost. The bats did not appear to change direction or avoid the antenna (personal observation). There were a few occasions where some individual bats actually flew up to the antenna as if to investigate the object. At the State of Texas Mine, the bats appeared to change their normal exit flight to avoid coming near the micro-chip antenna. One evening the bats refused to exit the roost until the antenna was removed. This is the only roost in southeastern and southwestern Arizona, and northern Mexico that we noticed any kind of negative behavior (avoidance) toward the antenna. The State of Texas Mine is the only roost we monitored for marked bats that is gated or has a chain barrier at the entrance. We did not observe any of the bats marked with the micro-chips with either the reader, antenna, night-vision goggles, or video cameras at the roosts in southeastern Arizona in August.

Radio Telemetry – We utilized the radio telemetry equipment at State of Texas Mine (Huachuca Mountains), Pyeatt Cave (Huachuca Mountains), and Patagonia Cave (Patagonia Mountains) to search for marked bats. The telemetry antenna was set up outside of these roosts and was usually placed 9-15 meters from the roost exit. We also utilized the telemetry equipment on several hilltops in the Chiricahua and Patagonia Mountains. On August 10, 2004 we located one of our marked bats in the Patagonia Mountains west of the Patagonia Cave. This female was originally marked at ORPI on July 20, 2004. This bat was detected two times (within a five minute period) with the radio telemetry as it flew in the valley of the Patagonia Mountains. The female had been marked 21 days earlier at ORPI before we detected her in the Patagonia Mountains (Table

7). She was last detected at ORPI nine days after the initial marking and then we could not locate her again in the ORPI area. The Patagonia Mountains are located about 211 kilometers southeast of the Copper Mountain roost where she was originally marked (Map 1). We did not locate any other marked bats with the telemetry equipment in the Huachuca, Chiricahua, or Patagonia Mountains.

Night-Vision Goggles/Video Cameras – We utilized the night-vision devices and the video cameras at the State of Texas Mine and the Patagonia Cave roosts to search for marked bats. We did not see any of the bats that had been marked with the micro-chip and reflective tape earlier in southwestern Arizona.

DISCUSSION

In the Americas, nectar-feeding bats are a diverse group comprising 36 species that mainly inhabit arid and semiarid lands (Koopman 1981, Valiente-Banuet et al. 1996a,b, Arita and Santos del Prado 1999). Nectar-feeding bats of the family Phyllostomidae (subfamily Glossophaginae) are known to pollinate the flowers of over 270 genera and 750 species of neotropical plants (Heithaus 1982, Dobat 1985). In North America, seasonal movements of *Leptonycteris curasoae* follow the flowering patterns of the plants that it consumes (Cockrum 1991, Fleming et al. 1993a, Fleming 1995). Cacti and agaves comprise much of the diet of nectar bats. The conservation of nectar corridors for *L. curasoae* not only benefits this species, it also helps a wide variety of other species that are in some way dependent on cactus or agaves (Fleming 2004).

Leptonycteris curasoae barely reaches the United States after migrating north from central Mexico (Fleming 2004). This species forms maternity colonies in southwestern Arizona and northern Mexico in the spring and either migrates back down to Mexico afterwards or to the southeastern mountains of Arizona to forage on the abundant agave. The bats forage along "latitudinally broad paths of blooming plants" as they migrate between their winter and summer habitats (Fleming et. al. 1993). One of the goals of the ASDM's Migratory Pollinator Program (MPP) was to identify migration corridors for *L. curasoae* from Jalisco to Arizona. Results from earlier studies (Wilkinson and Fleming 1996, Ceballos et al. 1997) on carbon stable isotope analysis and mitochondrial analysis indicated the migration routes of *L. curasoae* from Mexico to Arizona. However, we know little about post-maternity movements from roosts in southwestern Arizona. Data from previous studies indicate that in the spring *L. curasoae* utilizes crassulacean acid metabolism (CAM) plants like columnar cacti and then Calvin (C3) plants such as the paniculate agaves in late summer. The flowering phenologies and geographic distributions of these columnar cacti and paniculate agaves suggest that the bats migrate in and out of the Sonoran Desert along two different nectar corridors: a coastal cactus corridor in the spring and an inland agave corridor in the fall. Other data (Medellín pers. comm.) indicate that separate western coastal and inland mountain corridors exist, but there are also data that support sharing of corridors than a strict separation. Members of these populations may "jump" from the western corridor to the eastern (inland) corridor in Arizona. This may indicate that not all *L. curasoae* leave the maternity roosts in late summer to return to Mexico but some may travel to southeastern Arizona to forage on the abundant agave. During ASDM's MPP, Ted Fleming and I collected tissue samples from *L. curasoae* at the State of Texas Mine in the Huachuca Mountains. After analysis, the data indicated that the population of *L. curasoae* in southeastern

Arizona came from central Mexico (inland agave corridor) and not from Jalisco (coastal cactus corridor). These patterns emerged from an analysis of tissue samples from only 49 individuals, which attests to the power of genetic analysis for discerning large-scale movement patterns (Fleming 2004). For this study, DNA cheek samples were taken from 72 bats at the Copper Mountain roost. These are bats that travel the coastal cactus corridor. Dr. Melanie Culver (University of Arizona) is analyzing the DNA samples but we have no information on these data at this time. We utilized cheek swabs for the DNA collection instead of the common wing punches that have been used in the past. Dr. Culver was able to extract DNA from the captive bat (*M. californicus)* samples with the cheek swab technique and it is hoped that the samples from *L. curasoae* will be as successful.

A bat that was marked at ORPI at the Copper Mountain roost on July 20, 2004 was later located with radio telemetry in the mountains of Patagonia (21 days later). The bat was detected with the radio telemetry. We did not think the radio transmitters would be useful in locating marked bats in southeastern Arizona because of the short battery life. Timing was crucial to maximize the battery life of the transmitters. Locating a marked bat in southeastern Arizona indicates that at least one of the marked individuals moved east from the maternity roost in southwestern Arizona to the southeastern corner of the state. Biologists have suspected that some of the bats were moving east to take advantage of the rich nectar of the agave plants in the mountains of southeastern Arizona. This is the first evidence that *L. curasoae* may "jump" from the western corridor (coastal cactus) to the eastern corridor (inland agave) in Arizona. This project will be continued in 2005 to further test this hypothesis. Bats will once again be marked with radio transmitters and micro-chips in the southwestern part of the state (2 roosts) as well as northern Sonora (Pinacate roost). The more bats we can mark, the better our chances of locating a bat in southwestern Arizona.

The radio telemetry was also utilized to find out if marked bats were jumping from one roost to another in southwestern Arizona or northern Mexico. We did not locate any of the marked bats at other roosts in southwestern or southeastern Arizona, other than the bat we located in the Patagonia Mountains. This bat was picked up with the radio telemetry as it flew away from the Patagonia Cave and was probably foraging in the valley west of the roost (personal observation). We also followed the 11 bats marked with radio transmitters at ORPI. Our nightly tracking (Table 8 & 9) indicated that the females not only returned to the roost where they were marked but they continued to forage within this area. We were able to track marked females for up to two weeks following the initial marking session. Upon entering the Copper Mountain roost (after bats had left) one evening with Tim Tibbitts, we located a transmitter and micro-chip (with reflective tape) indicating that these two bats also returned to the roost after being marked. Our telemetry efforts each night also indicated that the bats marked with transmitters were returning to the roost (Copper Mountain).

The population dynamics of the Copper Mountain colony were unusual in one aspect in 2004, in a way contrary to expectations. With an estimated 90% failure of the 2004 saguaro-organ pipe bloom in the region (OPCNM Biologists' observations), food resources were severely limited. Considering that, the colony was expected to peak at a lower number than usual, and diminish early (by midsummer) as bats relocated elsewhere in search of scarce food. Instead, the colony reached abnormally high numbers early in the summer (mid-May), achieved a normal

level by late June, then remained at unusually high numbers through July and August (Figure 14). In typical years, numbers fall off through July and August, with most exit flight emergences during that time in the range of 9,000 to 17,000 bats (Figure 14; also see OPCNM 1999-2003). The August 21, 2004 estimate of 26,818 was the highest number ever recorded for July or August. On that date, cactus fruits were essentially absent from the landscape, to casual observation. The August 21 estimate compared with the highest estimates typical of late June in recent years, when the colony is usually at its peak. As Figure 14 suggests, in 2004 Copper Mountain may have supported the largest cumulative total number of bats-per-day through the summer, of all the years it has been monitored. This population dynamic, coincident with the largest known failure of its primary food sources, is as interesting as it is difficult to explain. It suggests *L. curasoae* is resilient to substantial changes in food availability. It may also suggest that, scarce as food resources were in the Organ Pipe region, conditions may have been as bad or worse elsewhere, forcing large numbers of bats to remain in Organ Pipe longer than usual. Our netting efforts on July 19, 20, 21 and on August 3rd, indicates that there were volant young of the year exiting this roost. The young handled during our netting appeared healthy and normal.

From the beginning, this project has gone through a lot of changes (i.e.-wristbands, necklaces) to determine the best and least harmful marking technique for *L. curasoae.* Discussions with Dr. Rodrigo Medellín and others indicated that both wristbands and necklaces as a marking technique for *L. curasoae* were not desirable for this species. Wristbands cause irritation and injuries for many species of phyllostomids. Dr. Medellín indicated that the *L. curasoae* netted after being marked with necklaces in Mexico, had injuries from their necklaces. Other marking techniques, like the micro-chip (PIT Tags), needed to be tested and developed. In an era of advanced technology, computer chips are making it possible to follow smaller organisms (without adding the burden of weight) and offer a more optimistic future for increasing knowledge. The computer chips have advanced but the technology to detect the chips (i.e. antenna) is still developing. We glued micro-chips with reflective tape on the backs of three *(M. californicus)* and 60 *(L. curasoae)* bats. The chip could be recognized with the night-vision, video cameras, and bright light for the captive study and in the field. The micro-chip antenna that was utilized in the field requires the bats to fly within 38 centimeters to be detected. Even though many of the bats flew within this distance, we did not record a single marked bat with the micro-chip reader/antenna at five different roosts in southern Arizona and northern Mexico. There were only 60 bats marked with the micro-chips and a larger number of marked bats may have increased our changes for detection at the roosts. For other studies, most micro-chips are implanted under the skin of the back of the animal and is a common technique for mammals, reptiles, fish, and some birds. This technique is used on both captive and wild animals and a hand-held reader can be utilized to read the chip. We did not have permission from USFWS to implant the chips to *L. curasoae* so tested the feasibility of micro-chips (with reflective tape) glued to the back of the bat. This marking technique seemed to work well with night-vision goggles and video cameras but the micro-chip antenna technology will have to be improved for future use. We will also continue to mark *L. curasoae* with radio transmitters since this is the method that produced a bat in southeastern Arizona three weeks after the initial marking. The major problem with using the transmitters to follow bats is the short battery life and timing is critical to maximize battery life. During meetings in Salt Lake City for the 34th Annual North American Symposium on Bat Research, Fred Anderka (a representative for Holohil Systems, Ltd.) suggested a different type of glue (gel) for the transmitters and micro-chips instead of the

skinbond adhesive that was used for this project. Mr. Anderka also said that he could increase the battery life of the transmitters (> 21 days) without adding too much more weight. If we can find a glue that will allow the transmitters and micro-chips to adhere to the back of the bats longer, we will have more time to search for bats in southeastern Arizona. Increased battery life for the transmitters will also give us more time to search for marked bats.

For 2005, we have requested that our USFWS permit be amended to allow us to mark a total of 175 bats at two roosts in southeastern Arizona. We have requested to mark 15 bats with radio transmitters and 140 bats with micro-chips. Additionally, we are requesting that USFWS allow us to implant 20 bats with a micro-chip. We are also seeking permission from Mexico to mark 25 bats at the Pinacate roost with micro-chips. Marking a total of 200 bats will increase our changes of locating more marked bats in 2005. We are also asking permission to collect DNA cheek samples from all bats handled. At this time, we are not certain how many bats USFWS will allow us to mark in 2005.

It is encouraging and exciting that we located a marked bat in southeastern Arizona (211 km east of ORPI) when we were only allowed (by permit) to mark 72 *L. curasoae*. The difficulties of studying an endangered species are obvious. More than 100,000 *L. curasoae* migrate to southern Arizona and northern Mexico each spring to have their young. Once the young are volant there are many more *L. curasoae* in Arizona and northern Mexico (personal observation) during the late summer. A trip to the Pinacate roost last July 30, 2004, indicated that there were more than the 100,000 bats exiting this one roost. At this time the young had been weaned (and were volant) and numerous bats were using this particular roost (personal observation). Looking for a small number of marked bats among thousands is difficult to say the least. Future research should include more marked bats and the development of new technology to search for them. In 2005, we would like to focus on marking *L. curasoae* with micro-chips with reflective tape, radio transmitters, and implant micro-chips to some of the bats in southwestern Arizona and northern Mexico and look for the marked bats in southeast Arizona. We hope to locate more marked bats in southeast Arizona indicating that female *L. curasoae* are moving from the coastal cactus corridor to the inland agave corridor.

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APPENDIX

FIELD DATA TABLES, RADIO TELEMETRY MAPS, AND FIGURE

Table 1: Bat netting data from the "Mission Bat Mine" in the Tucson Mountains (Irvington Road, Tucson) on April 7, 2004. Three nets (2-2.4 m, 1-6 m) located outside of the gated roost were opened at 1850 hours and closed at 1920 hours. Site coordinates are: [redacted] Weather conditions @ 1755 hours: Wind (2.2 to 5.9 mph), cloudy, temp (77.4° F); humidity (20.0 %); dew point (73.7° F); FA = forearm, WT = weight, mm = millimeters, g = grams, L = left, R = right, b/t = between, ** = bats collected for marking project, R = release date.
Biologists – Karen Krebbs and Ronnie Sidner;

TIME	SPECIES	SEX	FA (mm)	WT (g)	NOTES
1905	*Macrotus californicus*	F	50.9	12	
1905	*Macrotus californicus*	F	50.3	11	
1905	*Macrotus californicus*	F	49.9	11	Torn tip on L ear
1906	*Macrotus californicus*	F	50.2	12	
1906	*Macrotus californicus*	F	50.0	12	Mites on back of ears
1908	*Macrotus californicus*	F	49.7	12	2 streblids dorsal neck
1908	*Macrotus californicus*	F	49.5	13	
1910	*Macrotus californicus*	F	50.2	13	2 streblids on body
1912	*Macrotus californicus*	F	51.4	12	
1912	*Macrotus californicus*	F	49.8	12	2 streblids on body
1912	*Macrotus californicus*	M	51.6	12	All patagia w/ dull spots,Toothwear (1-6) & (2-3)
1912	*Macrotus californicus*	M	49.3	12	** **R = 4/27 04**
1912	*Macrotus californicus*	M	52.3	13	**
1913	*Macrotus californicus*	M	50.8	12	** Healed 1 cm slit L dactylopatagium (4&5), aggressive. **R = 4/27 04**
1913	*Macrotus californicus*	M	50.3	12	3 streblids, L eye injury, red L eye, blinking & favoring L eye
1915	*Macrotus californicus*	M	49.3	12	** 1 streblid. **R = 4/27 04**
1915	*Macrotus californicus*	M	48.7	11	**Faint scar b/t metacarpal 2 & 3, aggressive
1915	*Macrotus californicus*	M	51.8	13	** 1 streblid. **R = 5/6 04**
1916	*Macrotus californicus*	M	51.0	13	**
1916	*Macrotus californicus*	M	49.9	12	**
1917	*Macrotus californicus*	M	49.3	12	** Scar spots along tail & R uropatagium
1918	*Macrotus californicus*	M	49.8	12	** Aggressive. **R= 4/27 04**
TOTALS	22 BATS 1 SPECIES	10 F 12 M			

Ten males were collected and transported to the Arizona-Sonora Desert Museum (ASDM) on April 7, 2004 for captive marking project. One additional male (left eye injury) was kept under an AZGFD Bat Educational/Holding Permit (Karen Krebbs). Visits to roost include April 4, 2004 (scouting trip); April 7, 2004 (collecting); April 27, 2004 (released 4 bats and roost exit observations); May 6, 2004 (1 additional bat released and roost exit observations); May 29, 2004 (roost exit observations); June 20, 2004 (roost exit observations); July 16, 2004 (roost exit observations). Five bats remain at ASDM under the Mammalogy & Ornithology Department AZGFD permit (collecting/holding) and will be used in a planned future exhibit.

TABLE 2: Bat netting data from Copper Mountain Mine at Organ Pipe Cactus National Monument on July 19, 2004. At 2008 hours bats started exiting the roost. Three nets (2-6 m and 1-2.4 m) were set up southeast of the south exit, opened at 1930 hours, and closed at 2300 hours. Site coordinates are: [redacted] Two days after new moon, wind (3.1-4.5 mph), humidity (33%-36%), temperature 89.8° F (2040) and 90.8° F (2210). M = male, F = female, ? = unknown sex, g = grams, Juv = 2004 birth, *Le cu* = *Leptonycteris curasoae,* DNA = DNA sample taken, radio = radio transmitter (frequency) attached, chip = micro-chip attached, No wt. = unable to weigh bat, escaped = bat escaped before processing complete, mites = bat has insects on body, post lact = nipples still obvious but not lactating, SP = species. Biologists processing bats: Karen Krebbs, Tim Tibbitts, Ami Pate.

TIME	SPECIES	SEX	WEIGHT	NOTES
2024	*Le cu*	M	22 g	Juv; mites; DNA;
2030	*Le cu*	M	19 g	Juv; mites;
2030	*Le cu*	F	24 g	Adult; mites; DNA; radio (150.097);
2030	*Le cu*	M	23 g	Juv; mites; DNA;
2036	*Le cu*	M	20 g	Juv; mites; DNA;
2036	*Le cu*	M	20 g	Juv; mites; DNA;
2036	*Le cu*	?	No wt.	Escaped;
2053	*Le cu*	M	21 g	Juv; mites;
2100	*Le cu*	M	23 g	Juv; mites;
2103	*Le cu*	F	22 g	Juv; DNA;
2105	*Le cu*	F	20 g	Juv; DNA;
2105	*Le cu*	F	23 g	Juv; mites;
2105	*Le cu*	M	23 g	Juv; mites;
2105	*Le cu*	F	21 g	Adult; post lact; radio (150.138);
2105	*Le cu*	F	21 g	Juv;
2112	*Le cu*	M	24 g	Juv; DNA;
2117	*Le cu*	F	23 g	Adult; post lact; DNA;
2140	*Le cu*	F	26 g	Adult; post lact; DNA; radio (150.206);
2159	*Le cu*	F	No wt.	Juv; escaped;
2219	*Le cu*	M	18 g	Juv; DNA;
2238	*Le cu*	M	23 g	Juv; DNA;
TOTALS	**21 BATS 1 SP**	**11 M 9 F 1 ?**		**4 ADULTS, 16 JUVENILES, 1 UNKNOWN, 12 DNA SAMPLES, 3 RADIOS.**

TABLE 3: Bat netting data from Copper Mountain Mine at Organ Pipe Cactus National Monument on July 20, 2004. At 2010 hours bats started exiting the roost. Three nets (1-9 m, 1-6 m, 1-2.4 m) were set up southeast of the south exit, opened at 1930 hours, and closed at 0105 hours. Site coordinates are: [redacted]. Three days after new moon, wind (1.4-3.4 mph), humidity (32%), temperature 98.6° F (1930) and 92.1° F (2221). M = male, F = female, g = grams, Juv = 2004 birth, *Le cu* = *Leptonycteris curasoae,* DNA = DNA sample taken, radio = radio transmitter (frequency) attached, chip =micro-chip attached, No wt. = unable to weigh bat, escaped = bat escaped before processing complete, released = very young juveniles released without processing, mites = bat has insects on body, post lact = nipples still obvious but not lactating, SP = species, kms = kilometers. Biologists processing bats: Karen Krebbs, Tim Tibbitts, Ami Pate.

TIME	SPECIES	SEX	WEIGHT	NOTES
2025	*Le cu*	F	23 g	Juv; DNA;
2025	*Le cu*	F	22 g	Juv; DNA;
2025	*Le cu*	M	22 g	Juv; DNA;
2025	*Le cu*	F	20 g	Juv; DNA;
2027	*Le cu*	M	22 g	Juv; DNA;
2027	*Le cu*	M	21 g	Juv; DNA;

TABLE 3 continued				
2027	*Le cu*	M	21 g	Juv; DNA;
2027	*Le cu*	M	20 g	Juv; DNA;
2050	*Le cu*	F	22 g	Adult; post lact; DNA: radio(150.329)*
2050	*Le cu*	F	22 g	Adult; post lact; DNA; radio (150.427)
2050	*Le cu*	F	23 g	Adult; post lact: DNA; radio (150.608)
2050	*Le cu*	F	23 g	Adult; post lact; DNA; radio (150.228)
2052	*Le cu*	F	24 g	Adult; post lact; DNA;
2116	*Le cu*	F	No wt.	Juv; released;
2116	*Le cu*	M	No wt.	Juv; escaped;
2116	*Le cu*	M	No wt.	Juv; released;
2130	*Le cu*	M	23 g	Juv; DNA; radio (150.677)
2130	*Le cu*	F	22 g	Adult; post lact; DNA; chip;
2130	*Le cu*	F	22 g	Juv; DNA;
2130	*Le cu*	F	22 g	Juv; DNA;
2130	*Le cu*	M	22 g	Juv; DNA; chip;
2130	*Le cu*	F	23 g	Adult; chip:
2132	*Le cu*	M	21 g	Juv; chip;
2132	*Le cu*	F	23 g	Adult; chip;
2205	*Le cu*	F	21 g	Juv; DNA; chip;
2220	*Le cu*	M	22 g	Juv; DNA; chip;
2220	*Le cu*	F	24 g	Adult; DNA; chip;
2222	*Le cu*	F	23 g	Adult; DNA; chip;
2222	*Le cu*	F	20 g	Juv; DNA; chip; orange color on back**
2240	*Le cu*	M	20 g	Juv; DNA;
2250	*Le cu*	F	22 g	Adult; post lact; DNA;
2250	*Le cu*	F	24 g	Juv; DNA; radio (150.720);
2250	*Le cu*	F	25 g	Adult; post lact; DNA; chip:
2300	*Le cu*	M	24 g	Juv; DNA; chip;
2312	*Le cu*	F	23 g	Juv; DNA; chip;
2312	*Le cu*	F	22 g	Juv; DNA; chip;
2312	*Le cu*	M	27 g	Juv; DNA; chip:
2314	*Le cu*	F	25 g	Juv; DNA; chip;
2333	*Le cu*	F	23 g	Juv; DNA; chip;
2340	*Le cu*	M	23 g	Juv; DNA; radio (150.758);
2350	*Le cu*	M	23 g	Juv; DNA; chip;
2350	*Le cu*	M	25 g	Juv; DNA; chip;
2358	*Le cu*	M	21 g	Juv; DNA; chip;
2407	*Le cu*	M	19 g	Juv; DNA;
2410	*Le cu*	F	27 g	Juv; DNA; chip:
2410	*Le cu*	M	17 g	Juv; DNA;
2410	*Le cu*	F	25 g	Juv; DNA; chip;
2410	*Le cu*	F	21 g	Juv; DNA; chip;
2410	*Le cu*	F	24 g	Adult; post lact; DNA; chip;
2430	*Le cu*	F	26 g	Adult; post lact;
2434	*Le cu*	F	29 g	Adult; post lact; chip;
2442	*Le cu*	M	17 g	Juv;
0101	*Le cu*	F	21 g	Juv; chip;
0101	*Le cu*	F	25 g	Juv; chip;
0101	*Le cu*	M	23 g	Juv; radio (150.871);
0102	*Le cu*	F	25 g	Adult; post lact; chip;
TOTALS	**56 BATS 1 SP**	**22 M 34 F**		**15 ADULTS, 41 JUVENILES, 43 DNA SAMPLES, 8 RADIOS, 28 MICRO-CHIPS.**

TABLE 3 continued - * On August 10, 2004 at 2106 hours, the pulses from a radio transmitter (150.329 frequency) that was attached to a bat were detected with the telemetry equipment in the Patagonia Mountains. The series of radio beeps were heard twice within a 5-minute time period. The radio telemetry equipment was set-up outside [redacted] and directed towards the main drainage in the valley to the west. It appeared that the bat was flying in the valley and away from the [redacted]. This adult female bat was marked with the radio transmitter on July 20, 2004 at Organ Pipe Cactus National Monument and detected 211 kms (131 miles) to the southeast in the Patagonia Mountains.

****A juvenile female was netted that had an orange color on the fur (dorsal) side. The orange color appeared to be a stain and could not be rubbed off by the Biologist. We did could not determine how the bat obtained the stain. None of the other bats that we handled had the orange stain on their backs.**

TABLE 4: Bat netting data from Copper Mountain Mine at Organ Pipe Cactus National Monument on July 21, 2004. At 2015 hours bats started exiting the roost. Three nets (1-9 m, 1-6 m, 1-2.4 m) were set up southeast of the south exit, opened at 1921 hours, and closed at 2245 hours. Site coordinates are: [redacted] Four days after the new moon, wind (1.1-2.3 mph), humidity (37-40%), temperature 90.3° F (1921) and 87.6° F (2220). M = male, F = female, g = grams, Juv = 2004 birth, *Le cu* = *Leptonycteris curasoae,* DNA = DNA sample taken, radio = radio transmitter (frequency) attached, chip =micro-chip attached, No wt. = unable to weigh bat, escaped = bat escaped before processing complete, released = very young juveniles released without processing, mites = bat has insects on body, post lact = nipples still obvious but not lactating, SP = species, kms = kilometers, R = right, L = left. Biologists processing bats: Karen Krebbs, Tim Tibbitts, Ami Pate.

TIME	SPECIES	SEX	WEIGHT	NOTES
2020	*Le cu*	F	22 g	Juv; DNA; chip;
2020	*Le cu*	F	24 g	Juv; DNA; chip;
2034	*Le cu*	F	23 g	Adult; post lact; DNA; chip;
2034	*Le cu*	M	22 g	Juv; DNA; chip;
2034	*Le cu*	M	20 g	Juv; DNA; chip;
2034	*Le cu*	M	22 g	Juv; chip;
2040	*Le cu*	F	25 g	Adult; post lact; DNA; chip;
2040	*Le cu*	F	17 g	Juv; DNA;
2040	*Le cu*	F	21 g	Juv; DNA; chip;
2040	*Le cu*	M	21 g	Juv; DNA; chip;
2040	*Le cu*	M	21 g	Juv; DNA; chip;
2040	*Le cu*	M	21.5 g	Juv; DNA; chip;
2040	*Le cu*	F	22 g	Juv; DNA; chip;
2043	*Le cu*	M	19 g	Juv; chip;
2046	*Le cu*	F	22 g	Juv; DNA; chip;
2056	*Le cu*	M	21 g	Juv; DNA;
2112	*Le cu*	F	19 g	Juv; DNA; growth on R side of nose;
2115	*Le cu*	F	22 g	Juv; DNA; chip;
2115	*Le cu*	F	22 g	Juv; DNA; chip;
2115	*Le cu*	M	21 g	Juv; chip;
2115	*Le cu*	M	22 g	Juv; chip;
2134	*Le cu*	M	20 g	Juv; chip;
2135	*Le cu*	M	19 g	Juv; chip;
2135	*Le cu*	F	21 g	Juv; chip;
2135	*Le cu*	M	23 g	Juv; chip; healed scars on R & L legs;
2135	*Le cu*	M	20 g	Juv; chip;
2135	*Le cu*	M	24 g	Juv; chip;
2135	*Le cu*	M	19 g	Juv; chip;
2135	*Le cu*	F	22 g	Juv; chip;

TABLE 4 continued				
2159	*Le cu*	M	24 g	Juv; chip;
2159	*Le cu*	F	22 g	Juv; chip;
2200	*Le cu*	F	19 g	Juv; chip;
2212	*Le cu*	M	21 g	Juv; chip;
2212	*Le cu*	F	21 g	Juv; chip;
2216	*Le cu*	M	20 g	Juv; chip;
2230	*Le cu*	F	No wt.	Juv; released;
TOTALS	**36 BATS 1 SP**	**19 M 17 F**		**2 ADULTS, 34 JUVENILES, 17 DNA SAMPLES, 32 MICRO-CHIPS.**

TABLE 5: Bat netting data from Copper Mountain Mine at Organ Pipe Cactus National Monument on August 3, 2004. At 2000 hours bat started exiting the roost. One net (1-6 m) was set up southeast of the south exit, opened at 1930 hours, and closed at 2130 hours. Site coordinates are: [redacted] Three days after the full moon, wind (1.9-3.2 mph), humidity (19%), and temperature 90.3° F (1934 hours). M = male, F = female, g = grams, m = meter, mm = millimeter, Juv = 2004 birth, *Le cu* = *Leptonycteris curasoae,* FA = forearm measurement, and SP = species.

TIME	SPECIES	SEX	WEIGHT	NOTES
2012	*Le cu*	M	23 g	Juv; FA = 54 mm;
2012	*Le cu*	M	23 g	Juv; FA = 54 mm;
2025	*Le cu*	F	22 g	Juv; FA = 54 mm;
2052	*Le cu*	M	24 g	Juv; FA = 55 mm;
2122	*Le cu*	M	19 g	Juv; FA = 52 mm;
TOTALS	**5 BATS 1 SP**	**4 M 1 F**		**All bats were juveniles (2004 birth).**

Net was set-up for Mitch Tobin (Arizona Daily Star) and interview for *Leptonycteris curasoae* endangered species article (September 19, 2004).

TABLE 6: Field data notes. Elev. = elevation, OBS. = observation, m = meters, N = North Latitude (Lat), W = West Longitude (Long), radio = # of radio transmitters placed on backs of bats, DNA = DNA sample taken, chips = # of micro-chips placed on back of bats, camera = video camera and IR (infrared) lights, n-v = night-vision goggles, hrs. = hours, reader = micro-chip reader and antenna, telemetry (#) = radio telemetry equipment set up and # marked bats detected w/equipment, Mtn. = Mountain, Chir. = Chiricahua, Huach. = Huachuca, Pat. = Patagonia.

LOCATION	DATE	GPS (Lat/Long)	ELEV. (m)	TIME (hrs.)	NOTES
Copper Mtn. (South Exit)	7/19/04	[redacted]	[redacted]	1930 to 2300	Marked bats; radio (3); DNA (12);
Copper Mtn. (South Exit)	7/20/04	[redacted]	[redacted]	1930 to 0105	Marked bats; radio (8); DNA (43); chips (28);
Copper Mtn. (South Exit)	7/21/04	[redacted]	[redacted]	1921 to 2245	Marked bats; DNA (17); chips (32);
Bluebird Mine & Copper Mtn. (South Exit)	7/22/04	[redacted]	[redacted]	1900 to 2200	Search for marked bats; camera; n-v; reader; telemetry (0 bats); Telemetry (4 bats) @ Copper Mtn.;

TABLE 6 continued				
Copper Mtn. (South Exit)	7/23/04		1930 to 2245	Search for marked bats; camera; n-v; reader; telemetry (3 bats);
Copper Mtn. (North & South Exit)	7/26/04		1930 to 2400	Search for marked bats; 2 cameras; n-v; reader; telemetry (7 bats);
Copper Mtn. (North & South Exit)	7/27/04		1900 to 2400	Search for marked bats; 2 cameras; n-v; reader; telemetry (6 bats);
Copper Mtn. (North Exit)	7/29/04		1900 to 2230	Search for marked bats; 1 camera; n-v; reader; telemetry (4 bats);
Pinacate Roost	7/30/04		1900 to 2300	Search for marked bats; 1 camera; reader; telemetry (0 bats);
Copper Mtn. (North Exit)	8/02/04		1900 to 2200	Search for marked bats; 1 camera; n-v; reader; telemetry (2 bats);
Copper Mtn. (South Exit)	8/03/04		1900 to 2200	Search for marked bats; reader; telemetry (1 bat) @ Copper Mtn. & (2 bats) @ Ajo Mtn. Loop; 1-6 m net; AZ Daily Star interview;
Huach. Mtn.	8/05/04		1900 to 2300	Search for marked bats; n-v; telemetry (0 bats);
Chir. Mtn.	8/07/04		0100-0230	Search for marked bats; telemetry (0 bats);
Huach. Mtn.	8/09/04		1900- 2300	Search for marked bats; telemetry (0 bats);
Patag. Mtn.	8/10/04		1920-2300	Search for marked bats; 1 camera; n-v; reader; telemetry (1 bat, #329);
Huach. Mtn.	8/11/04		1900-2130	Search for marked bats; 1 camera; n-v; reader; telemetry (0 bats);
Patag. Mtn.	8/12/04		1900-2200	Search for marked bats; n-v; telemetry (0 bats);
Chir. Mtn.	8/13/04		0100--0230	Search for marked bats; telemetry (0 bats);
Patag. Mtn.	8/16/04		1900-2230	Search for marked bats; n-v; telemetry (0 bats);
Huach. Mtn.	8/17/04		1900-2200	Search for marked bats; 1 camera; n-v; reader; telemetry (0 bats);
Patag. Mtn.	8/18/04		1900-2300	Search for marked bats; n-v; telemetry (0 bats);
Patag. Mtn.	8/20/04		1900-2200	Search for marked bats; n-v; telemetry (0 bats);
Huach. Mtn.	8/21/04		1900-2200	Search for marked bats; 1 camera; n-v; reader; telemetry (0 bats);

TABLE 6 continued					
Huach. Mtn.	8/23/04	[redacted]	[redacted]	1900-2230	Search for marked bats; telemetry (0 bats);
Patag. Mtn.	8/24/04	[redacted]	[redacted]	1900-2300	Search for marked bats; n-v; telemetry (0 bats);
Patag. Mtn.	8/26/04	[redacted]	[redacted]	1900-2300	Search for marked bats; n-v; telemetry (0 bats);
Patag. Mtn.	8/30/04	[redacted]	[redacted]	1900-2300	Search for marked bats; n-v; telemetry (0 bats);

TABLE 7: Data on *L. curasoae* marked in southwestern Arizona and later detected in southeastern Arizona. Lat = Latitude, Long = Longitude, N = North, W = West, ELEV. = elevation, Mtn. = Mountain, ORPI = Organ Pipe Cactus National Monument, g = grams, m = meters, @ = at, DNA = DNA sample taken; radio = radio transmitter (frequency) attached, hrs. = hours, min. = minutes, w = with, telem. = radio telemetry equipment, 2X = two times.

LOCATION	DATE	GPS (Lat/Long)	ELEV. meters	DATA	NOTES
Copper Mtn. ORPI	7/20/04	[redacted]	[redacted]	1 - F; Adult; 22 g weight; Post lactating;	Bat caught @ 2050 hrs. in 2.4 m net set outside south exit; DNA; radio(150.329);
Patagonia Bat Roost	8/10/04	[redacted]	[redacted]	Bat detected @ 2106 hrs. w/telem. west of bat cave in Patagonia Mtn.	Bat was last detected on 7/29 @ ORPI @ the maternity roost.

TABLE 8: Radio telemetry data from Organ Pipe Cactus National Monument from July 19 to August 3, 2004. Eleven *Leptonycteris curasoae* were marked with transmitters and followed for 2 weeks afterwards. TRANS. = Transmitter, FREQ. = Frequency, MARK = marked, X = bat was detected with telemetry equipment, ORPI = Organ Pipe Cactus National Monument.

TRANS. FREQ.	ORIGINAL MARK DATE	BAT DETECTION DATES FOR JULY AND AUGUST									
		19	20	21	22	23	26	27	29	2	3
150.097	07/19/04	X			X	X	X	X		X	X
150.138	07/19/04	X			X		X	X			
150.206	07/19/04	X					X		X		
150.228	07/20/04		X					X			
150.329*	07/20/04		X		X		X		X		
150.427	07/20/04		X								
150.608	07/20/04		X				X	X	X		
150.677	07/20/04		X		X	X	X	X	X		
150.720	07/20/04		X				X	X		X	X
150.758	07/20/04		X								
150.871	07/20/04		X				X	X			

- **Female marked on July 20, 2004 at ORPI with radio transmitter frequency # 150.329 detected in the Patagonia Mountains on August 10, 2004.**

TABLE 9: Summary for *Leptonycteris curasoae* radio telemetry tracking results at ORPI and southeastern Arizona (Frequency 329), July-August 2004.

Frequency **097**	Adult female	
Date	**Times Detected**	**General Location/Movement**
7-19-04	transmitter attached	
7-22-04	20:56, 21:07, 21:08	NW of Copper Mtn
7-23-04	20:48 - 20:51	W of Copper Mtn
7-23-04	20:58 - 21:00	S/SE of Copper Mtn
7-26-04	20:40 - 21:09	Appeared to exit from south roost entrance, then circled northeast towards [redacted] Canyon. Flew south along west flank of [redacted] Range across [redacted] Wash; signal disappeared south/southeast of southernmost telemetry stations.
7-27-04	20:48 - 21:40	Very similar movement pattern as 7-26-04, with signal disappearing south/southeast of southernmost telemetry stations 30 minutes later than previous evening.
7-29-04	not detected	
8-2-04	20:32 - 20:34; 20:38	S/SE of Copper Mtn
8-3-04	20:32; 20:43	Vicinity of Copper Mtn
8-3-04	21:05 - 21:09	West flank of [redacted] Range

Frequency **138**	Adult female, post-lactating	
Date	**Times Detected**	**General Location/Movement**
7-19-04	transmitter attached	
7-22-04	20:14 – 20:21	S of Copper Mtn, moving to SE of Copper Mtn
7-23-04	not detected	
7-26-04	21:00 – 21:04	SW of [redacted] Canyon
7-27-04	20:20 – 20:39	Probably exited from Copper Mtn south entrance. Flew quickly and directly SE to mouth of [redacted] Canyon; appeared to fly up [redacted] Canyon, where signal was lost.
7-29-04	not detected	
8-2-04	not detected	
8-3-04	not detected	

Frequency **206**	Adult female, post-lactating	
Date	**Times Detected**	**General Location/Movement**
7-19-04	transmitter attached	

TABLE 9 continued		
7-22-04	not detected	
7-23-04	not detected	
7-26-04	21:06, 21:08, 21:10	NW of [redacted] Canyon
7-27-04	not detected	
7-29-04	20:36 – 20:37	S of Copper Mtn
8-2-04	not detected	
8-3-04	not detected	

Frequency **228**	Adult female, post-lactating	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	not detected	
7-23-04	not detected	
7-26-04	not detected	
7-27-04	22:46 – 22:47	Questionable detection.
7-29-04	not detected	
8-2-04	not detected	
8-3-04	not detected	

Frequency **329**	Adult female, post-lactating	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	20:47 – 20:54	Moving from S to SE of Copper Mtn
7-23-04	not detected	
7-26-04	20:34	S of Copper Mtn
7-26-04	22:13 – 22:19	Detected moving west out of [redacted] Canyon mouth, near [redacted] Canyon road.
7-27-04	not detected	
7-29-04	22:00 – 22:06	S of Copper Mtn
8-2-04	not detected	
8-3-04	not detected	
8-10-04	21:06 – 21:08	Moving west away from [redacted] Cave in Patagonia Mountains in southeast Arizona

TABLE 9 continued		
Frequency **427**	Adult female, post-lactating	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	not detected	
7-23-04	not detected	
7-26-04	not detected	
7-26-04	not detected	
7-27-04	not detected	
7-29-04	not detected	
8-2-04	not detected	
8-3-04	not detected	

Frequency **608**	Adult female, post-lactating	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	not detected	
7-23-04	not detected	
7-26-04	21:25 – 21:30	SW of [redacted] Canyon.
7-26-04	21:50 – 21:55	Moving to [redacted] Canyon area.
7-26-04	22:04 – 22:08	Moving to [redacted] Canyon area.
7-26-04	22:22 – 23:22	Active in [redacted] Canyon bajada and upper slopes.
7-27-04	20:46 – 21:26	First detected SE of Copper Mtn, appears to fly quickly and directly S/SE along west edge of [redacted] Range, south of [redacted] Canyon.
7-27-04	21:59	Detected W of [redacted] Canyon
7-29-04	21:09 – 21:14; 21:19 – 21:20; 21:24	S of Copper Mtn
8-2-04	not detected	
8-3-04	not detected	

Frequency **677**	Juvenile male	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	21:11 – 21:13	S of Copper Mtn

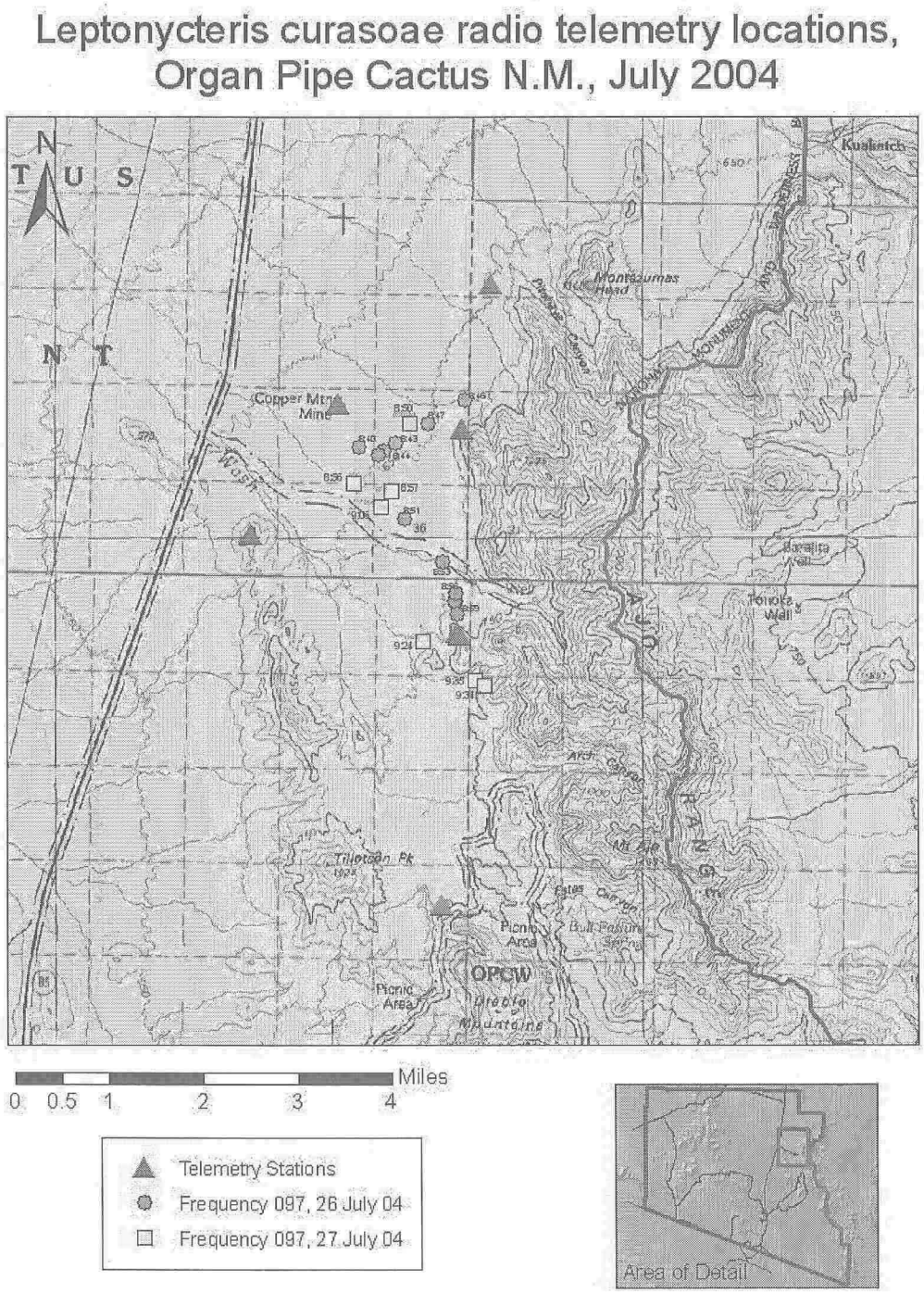
TABLE 9 continued		
7-23-04	21:13 – 21:17	S/SE of Copper Mtn
7-26-04	21:10 – 21:46	Appears to exit from north roost entrance and flies quickly and directly S/SE along western edge of [redacted] range; signal disappears near mouth of [redacted] Canyon.
7-27-04	20:55 – 20:57	SW of [redacted] Canyon
7-27-04	21:39 – 22:18	Flies from slightly NE of Copper Mtn to SE, then veers SW to east side of mountains north of [redacted] Peak. Flies south along these mountains; signal disappears near [redacted] Canyon, as the previous night.
7-27-04	22:26 – 22:27	SE of Copper Mtn
7-29-04	21:36 – 21:40	S of Copper Mtn
8-2-04	not detected	
8-3-04	not detected	

Frequency 720	Juvenile female	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	not detected	
7-23-04	not detected	
7-26-04	22:21 – 22:52	W of [redacted] Canyon
7-27-04	21:58	Bajada on S side of [redacted] Canyon.
7-27-04	22:20 – 22:29	Detected NW of [redacted] Canyon, then flies S/SE back to bajada on S side of [redacted] Canyon.
7-29-04	not detected	
8-2-04	20:41 – 21:16 (intermittently)	NE of Copper Mtn
8-3-04	20:57	N of Copper Mtn

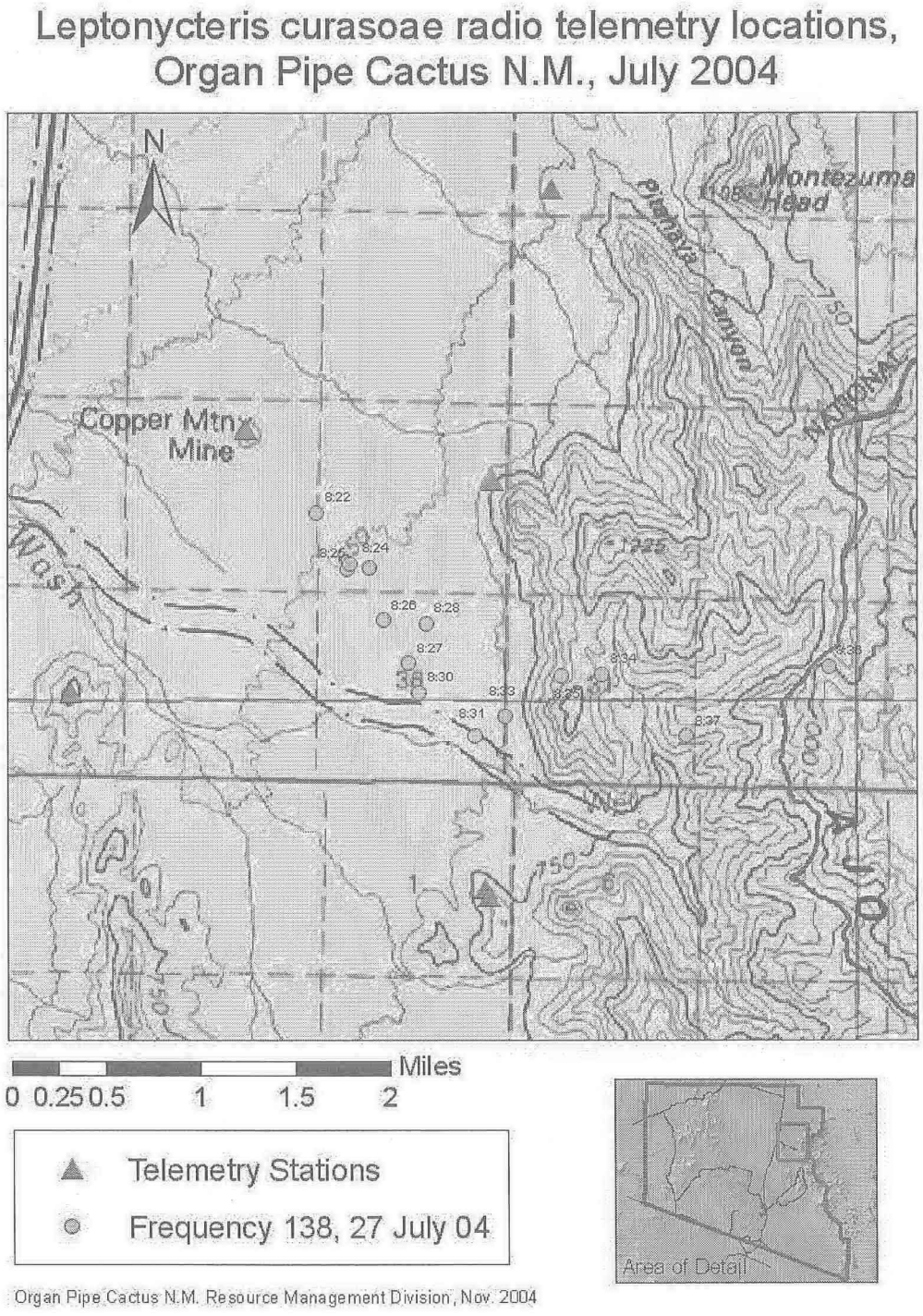
Frequency 758	Juvenile male	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	
7-22-04	not detected	
7-23-04	not detected	
7-26-04	dropped transmitter found	Copper Mtn roost

Frequency 871	Juvenile male	
Date	**Times Detected**	**General Location/Movement**
7-20-04	transmitter attached	

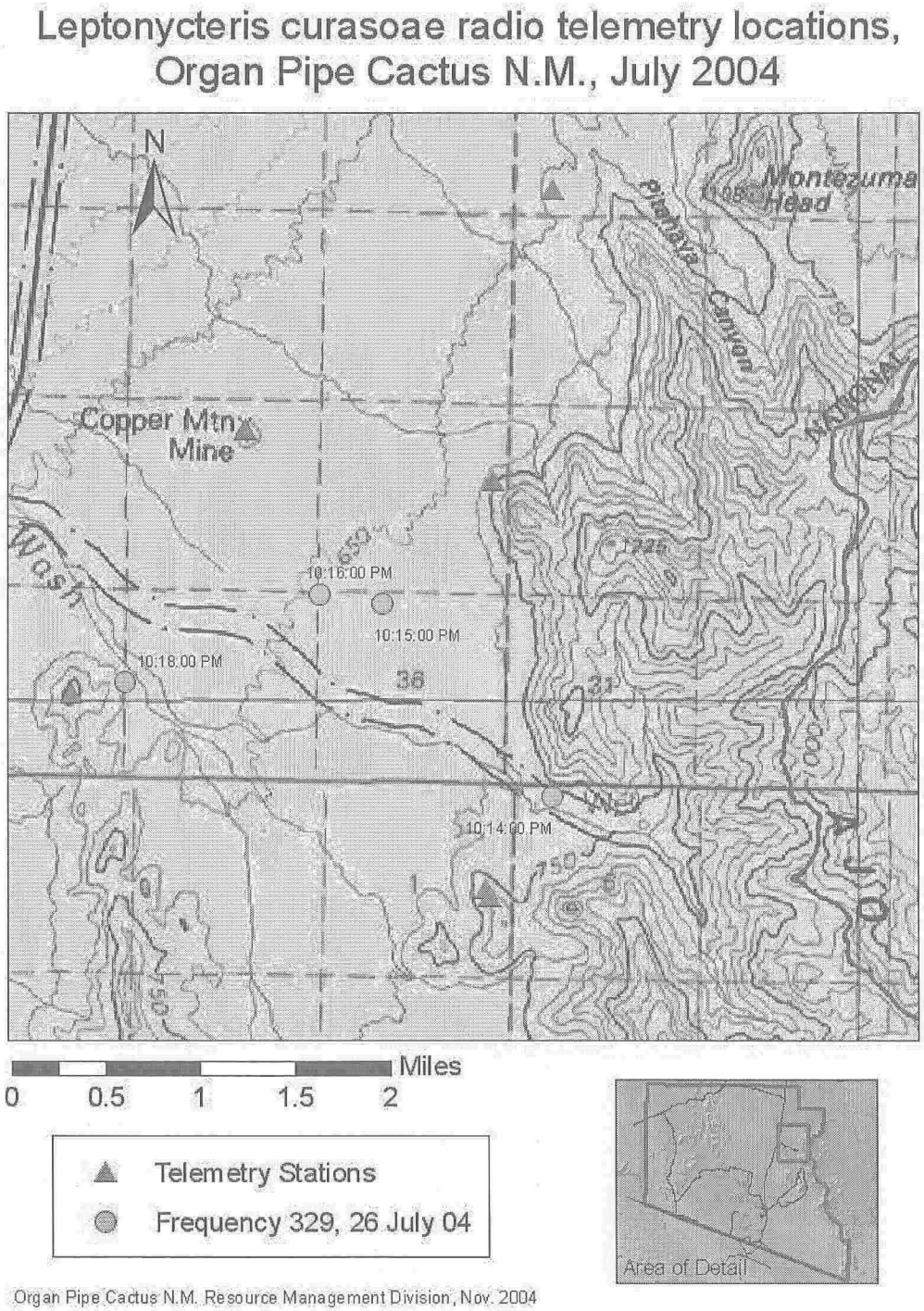
TABLE 9 continued		
7-22-04	not detected	
7-23-04	not detected	
7-26-04	20:27 – 20:43	Moving NW to NE of [redacted] Canyon
7-27-04	20:39 – 20:45	East side of Copper Mtn
7-27-04	20:48; 20:53; 20:54	Appears to be flying up [redacted] Canyon
7-29-04	not detected	
8-2-04	not detected	
8-3-04	not detected	



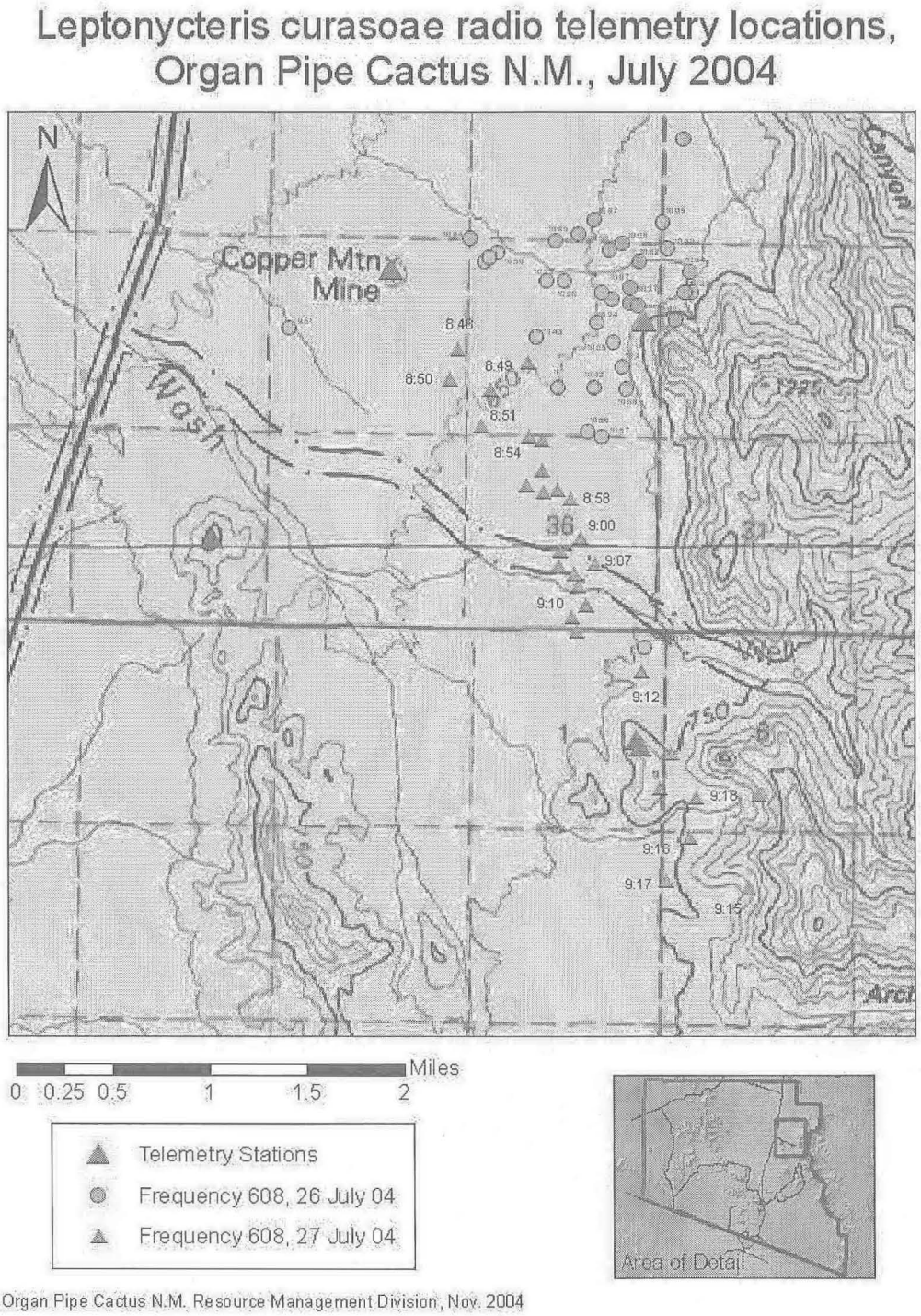
Map 2: Tracking results at ORPI for *L. curasoae* frequency 097.



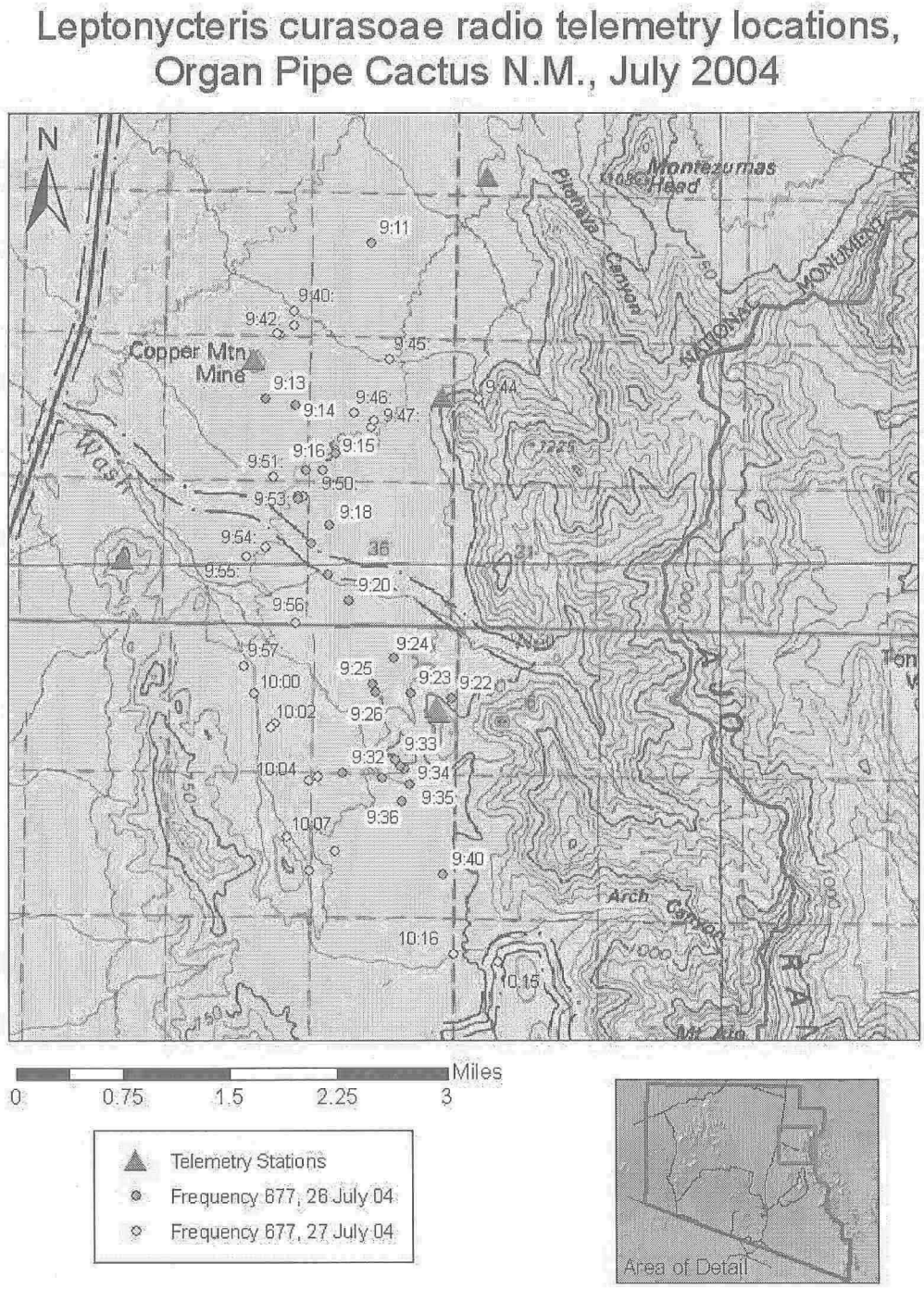
Map 3: Tracking results at ORPI for *L. curasoae* frequency 138.



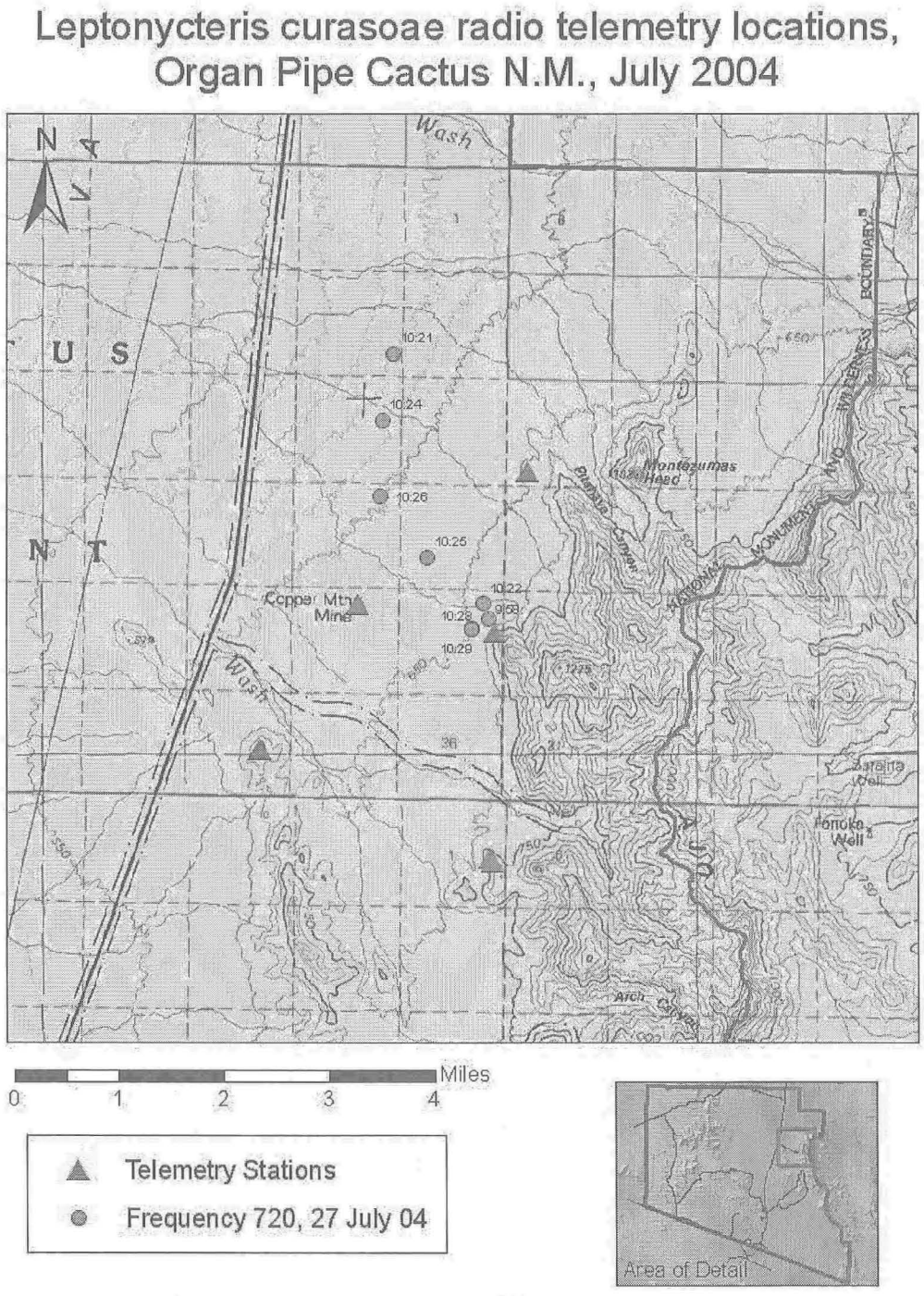
Map 4: Tracking results at ORPI for *L. curasoae* frequency 329. This female was detected in the Patagonia Mountains (211 km east of ORPI) on August 10, 2004.



Map 5: Tracking results at ORPI for *L. curasoae* frequency 608.



Map 6: Tracking results at ORPI for *L. curasoae* frequency 677.



Map 7: Tracking results at ORPI for *L. curasoae* frequency 720.

Leptonycteris curasoae average exit flight estimates for 1999-2004 at Copper Mountain Roost

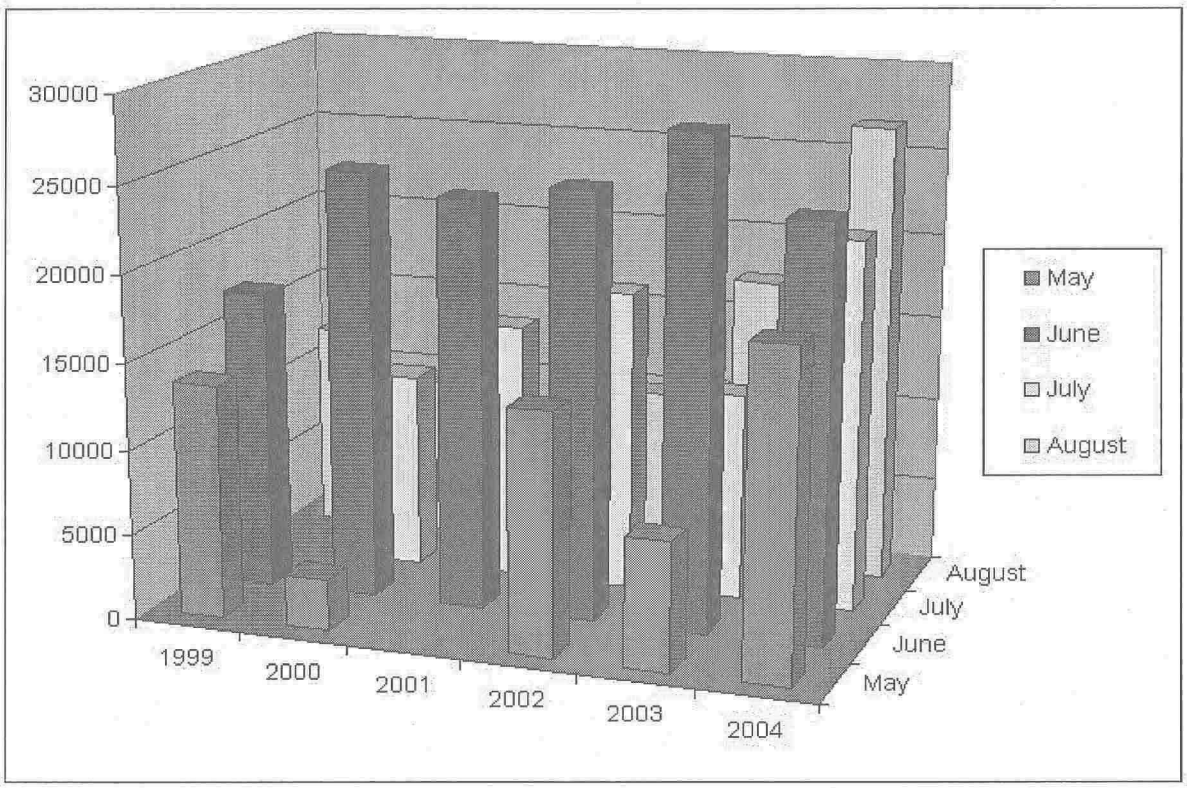


Figure 14: Average of exit flight estimates for each month, for *Leptonycteris curasoae* at Copper Mountain, 1999-2004. Organ Pipe Cactus National Monument, Arizona. (No estimates were done in July 1999, May 2001, August 2001.) (OPCNM 2004)

Understanding the Fall Migration of the Endangered Lesser Long-Nosed Bat (*Leptonycteris curasoae)* An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinator Program (2-year project)

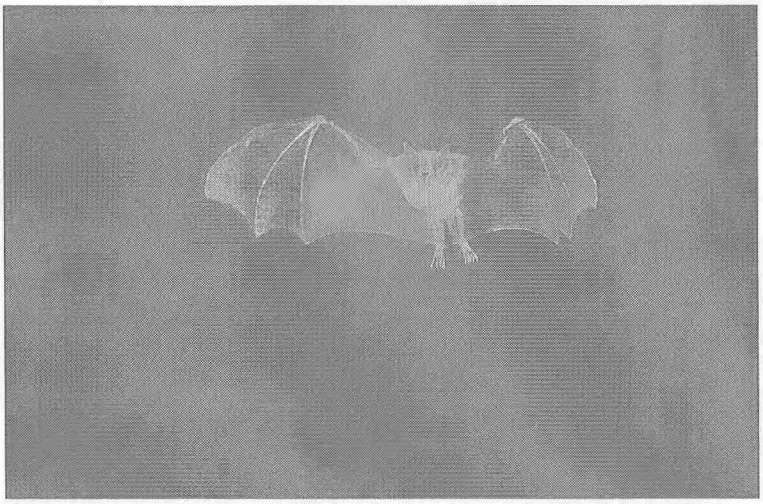
Second Year (2005) Final Report

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January 2006

Prepared for: The National Park Service, The Arizona Game & Fish Department, The U.S. Fish & Wildlife Service, and The Arizona-Sonora Desert Museum.



Leptonycteris curasoae in flight. Photo: Bruce D. Taubert, AZGFD

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EXECUTIVE SUMMARY

In July and August 2005, we continued to test a marker on *Leptonycteris curasoae* at two maternity roosts in southwestern Arizona and attempted to follow the marked bats to other roosts and to the southeastern part of the state. Our objectives in 2005 in this study were to: 1) test micro-chips (passive integrated transponder tags) with reflective tape on *L. curasoae*, 2) obtain information on the movements of *L. curasoae* in Arizona from their maternity roosts to southeastern Arizona, 3) determine if the bats were moving from one roost to another in southwestern Arizona and obtain information on timing of the bats' movements, and 4) collect DNA from *L. curasoae* at the maternity roosts where the bats were marked. In 2005, we continued to test the feasibility of using cheek swabs as a method for collecting DNA.

We accomplished all of our objectives with the exception of one. We were not able to determine if bats were moving from one roost to another in southwestern Arizona. Captive studies with *M. californicus* in 2004 at the Arizona-Sonora Desert Museum (see first year report for 2004) indicated that the micro-chip (PIT Tag) with reflective tape was the best marker that we tested to utilize for the fieldwork with the *L. curasoae* in both the 2004 and 2005 field season. The micro-chips with reflective tape were glued on the backs of 24 *L. curasoae* in July and August, 2005 at the Copper Mountain and Bluebird Mine maternity roosts. Eleven additional bats were fitted with radio transmitters and DNA collected from 69 bats (as per Federal permit). DNA samples were turned over to Dr. Melanie Culver at the University of Arizona. In southeastern Arizona, roost checks were made at the State of Texas Mine (Huachuca Mountains), Patagonia Cave (Patagonia Mountains), Pyeatt Cave (Huachuca Mountains), Hilltop Mine (Chiricahua Mountains), and Buckelew Mine (Chiricahua Mountains). Telemetry scanning for bats marked with radio transmitters was carried out at various other locations in the Chiricahua, Patagonia, Huachuca, Dragoon, Whetstone, Tucson, Dos Cabeza, Mustang, Catalina, and Rincon Mountains. Additional checks were made in the Canelo Hills and Kino Springs areas. Radio telemetry equipment, video cameras with IR lights, night-vision goggles, and a micro-chip reader/antenna were utilized outside of roosts to search for marked bats. Micro-chips with reflective tape could be detected with the night-vision goggles, video cameras, and light. The micro-chip reader and customized antenna were installed by a Biomark representative and biologists at the entrance of the south exit of the Copper Mountain roost. The antenna detected five of the bats marked with micro-chips at the Copper Mountain roost. The special antenna was not moved to other roosts as in 2004.

Two female bats (1 adult and 1-2005 birth) that were marked at the Copper Mountain maternity roost (OPCNM) were detected with the radio telemetry equipment near the Mustang and Whetstone Mountains in southeast Arizona. The adult female bat was detected on three different occasions in two different mountain ranges (Mustang and Whetstone) and the young female detected once near the Whetstone Mountains. The Mustang Mountains are located about 228 kilometers and the Whetstone Mountains about 243 kilometers southeast of OPCNM. During this two-year study (2004-2005), we have documented three female *L. curasoae* (2 adults and 1 subadult) that have migrated

from southwest Arizona to the southeastern corner of the state and may indicate that this species is moving between the coastal and inland corridors.

The Copper Mountain and Bluebird Mine bat netting provided important information on both adult females and young of the year. We also obtained excellent information on the movements of young bats at the roost with the customized antenna. At the time we carried out the fieldwork (July) at both of the mines, it appeared that the majority of the bats remaining at the two maternity roosts were young of the year (from the netting) and we assumed that the adult females had moved to other areas. We also obtained data on volant young of the year from our netting sessions.

ACKNOWLEDGEMENTS

This project was funded by the National Park Service (NPS), Arizona Game and Fish Department (AZGFD), American Zoo and Aquarium Association Bat Taxon Advisory Group (AZA Bat TAG), and the Arizona-Sonora Desert Museum (ASDM). National Park Service employees Barbara Alberti (Coronado National Memorial), Larry Norris (Southwest Research Coordinator), and Tim Tibbitts (Endangered Species Coordinator) provided contacts, guidance, and support for the project. Angie McIntire (AZGFD Bat Project Coordinator) also supported the project with help for permits, funding, direction, and advice. Permitting agencies or organizations included the NPS, AZGFD, USFWS, U.S. Forest Service, State Parks, AZA, United States Department of Agriculture (USDA), and ASDM provided the permits necessary for the two-year project. Agency biologists and employees Kathy Billings, Fred Patton, Peter Holm, Barbara Alberti, Tim Tibbitts, Ami Pate, Guy Jontz, Sherry Mann, Larry Norris, Bonnie Stolp, Angie McIntire, Tim Snow, Scott Richardson, Mike Coffeen, Lyle Lewis, Warren Striplin, Curt McCasland, Ginger Nolan, Jo Ann Roberts, Nicki Cook, Gary Helbing, Debbie Sebesta, and Tom Deecken provided help, input, and guidance throughout the project duration. Dr. Melanie Culver provided the swabs for DNA collection, instructions for collecting, and analyzed the samples.

Tim Tibbitts, Ami Pate, Curtis McCasland, Angie McIntire, Alicia Sweezer, Doug Sweezer, Barbara Alberti, Sherry Mann, Antje Adams, Adam Hinckle, Eugenio Larios, Nicki Cook, Robert Graf, and Anne Graf helped with the fieldwork and radio telemetry. Curt McCasland carried a heavy tarp trap to the Bluebird Mine for our fieldwork despite his injured leg. Tim Tibbitts provided the graphs for the bat abundance at the maternity roost for 1999 to 2005. Tim also endure numerous meetings with the NPS to insure that we be allowed to carry out the second year of field research at OPCNM. Tim, Ami, and Nicki enthusiastically helped in the field at OPCNM despite their normal work routine and responsibilities. Guy Jontz accompanied the field crew to the Copper Mountain roost for our protection. Dr. Ronnie Sidner helped with the initial captive work at ASDM and her involvement was appreciated. Ronnie also looked for marked bats at the Pyeatt Cave in August. Debbie Buecher scanned for marked bats at her study locations. I appreciate the help of Tim Tibbitts, Ami Pate, Barbara Alberti,

Sherry Mann, Curt McCasland, Eugenio Larius, Tim Snow, Robert Graf, and Anne Graf at the roosts in Arizona. Dr. Rodrigo Medellin's support for the entire project, input on the marking of *L. curasoae,* and the work in Mexico was appreciated.

Tani Hubbard helped with funding problems, grant questions, and helped edit the final report. Kim Duffek, Dr. Richard Brusca, and Dr. Christine Conte also helped edit the report. Robert Graf worked on maps for the final report and this was greatly appreciated. Dale and Pat Young helped with the scanning of slides/pictures, downloaded digital images of the fieldwork, and generously loaned their digital camera for the fieldwork. Laurence Fahrney helped with computer problems and assistance. Laurence also suggested that we make the report available on the web site for all agency employees. Laurence and Rocco Santangelo helped with the downloading of the TAG reader data. I want to thank the companies and their employees Biomark (Brian Beckley, Audrey Hopkins) and Holohil Systems Ltd. (Fred Anderka) for their assistance and advice. Greg Crooks helped with all the ordering and information requests. Dr. Virginia Dalton provided input on the marking. Pictures are the property of Karen Krebbs unless otherwise stated. I want to thank Bruce D. Taubert (AZGFD) for use of his *L. curasoae* photos for this report.

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GPS Coordinate Information

I have intentionally not included any of the GPS coordinates and similar information for this report to protect the endangered lesser long-nosed bat, roost locations, and foraging habitat. I have however, provided this information in a separate document to the permit granting agencies requesting the sensitive information for this project.

INTRODUCTION

The lesser long-nosed bat (*Leptonycteris curasoae)* is a federally listed (endangered) species in both the United States and Mexico (Cockrum and Petryszyn 1991). Relatively few species of bats undergo long distance migrations. More than one hundred thousand female lesser long-nosed bats migrate into northern Sonora, Mexico and southern Arizona each spring to establish maternity colonies and give birth to their young (Fleming and Eby 2003). Lesser long-nosed bats depend upon columnar cactus during their northern migration and agaves, tropical trees, and shrubs when they migrate south for the winter. These migratory corridors, or "nectar corridors" consist of a series of stepping-stones, or patches of flowering plants, that provide nectar for refueling during

migration along 2000-6000 km flyways (Nabhan and Brusca 2002). After migrating north, females give birth to a single pup in northern maternity roosts like the Copper Mountain Mine, Bluebird Mine, and the Pinacate roosts. After the young are weaned, it is not clear if the mothers and young in the southwestern part of Arizona move back down to Mexico in late summer or travel to the southeast corner of the state to utilize the rich quantity of agave nectar. Usually when large numbers of *L. curasoae* appear in southeastern Arizona, the maternity colonies in southwestern Arizona and northern Mexico show a complementary decrease in numbers of bats (Tibbitts, McCasland, and Alberti pers. comm.).

The late summer departure of bats from their maternity roosts is correlated with declining resource levels and perhaps weather/climate conditions (Nabhan and Brusca 2002). Research conducted by the Arizona-Sonora Desert Museum (ASDM) and Dr. Theodore Fleming for the Migratory Pollinator Program in the late 1990's indicated that *L. curasoae* are using two different migration paths (corridors) to reach northern Sonora and southern Arizona. Fleming (Data from the Migratory Pollinator Program) reports that migrating females are more likely to move within a corridor than between corridors (Nabhan and Brusca 2002). Whether *L. curasoae* are moving between corridors (i.e.- from southwest Arizona to southeast Arizona) after the young are volant or moving directly south into Mexico has never been tested. This project tested different marking techniques, observed movements of this species within Arizona, investigated possible departure points for the southward fall migration to Mexico, and collected DNA at two maternity roosts in southwestern Arizona. We also obtained data on *L. curasoae* during the netting at Copper Mountain and Bluebird Mine that indicated the physical conditions of adult females after weaning of the young (Tables 1- 4).

Making empirical observations of individuals that may switch corridors required that we use semi-permanent, visible markers such as reflective tape on wing bands (Kunz 1996), or on necklaces (Handley et al. 1991, Isaac et al. 2003), passive integrated transponders tags (O'Shea et al. 2003), fluorescent powder (Kunz 1996), or radio transmitters (Ober et al. 2000, Neubaum et al. 2003) to confirm if individuals are using or switching migratory corridors. Several different marking techniques were first tested on a captive population of *M. californicus* in 2004 at the ASDM (Krebbs et. al. 2005). From our captive study, we concluded that micro-chips with reflective tape were the best markers we had tested to utilize on *L. curasoae* in the field. We also utilized radio telemetry, a commonly used technique to follow bats locally, to follow the bats in Arizona (southeast and southwest) and northern Mexico. In the field we glued micro-chips (with reflective tape) on the backs of 24 *L. curasoae* and radio transmitters on 11 bats (Table 1-4). We searched for the 35 marked bats at roosts in southwestern and southeastern Arizona. Two of the marked bats were located near the Mustang and Whetstone Mountains (Table 5) with the radio telemetry. In 2004, we located one of our marked bats in the Patagonia Mountains (Table 5). This is the first evidence that *L. curasoae* is moving between migratory corridors in Arizona. Studies in the future can indicate if more bats are moving from the southwestern corner of Arizona to the southeast.

OBJECTIVES

1) Test micro-chips (passive integrated transponder tags) with reflective tape as a marker on *L. curasoae.*

2) Obtain information on the movements of *L. curasoae* in Arizona from their maternity roosts to southeastern Arizona.

3) Determine if the bats are moving from one roost to another and obtain information on timing of the bats' movements or departures from the roost.

4) Collect DNA from *L. curasoae* at the maternity roosts where the bats were marked. Test the feasibility of using cheek swabs as a method for collecting DNA instead of the standard wing punches.

METHODS

The fieldwork with *L. curasoae* was carried out in July and August 2005 at OPCNM, the Cabeza Prieta National Wildlife Refuge (NWR) in southwestern Arizona, and in or near the mountains of southeastern Arizona (Chiricahua, Huachuca, Patagonia, Dragoon, Mustang, Dos Cabeza, Tucson, Rincon, Whetstone, Catalina).

Fieldwork – Southwestern Arizona

Copper Mountain Maternity Roost – Copper Mountain is a maternity roost used by female *L. curasoae* in late spring and summer each year. The females migrate to southwestern Arizona in late spring from southern Mexico. The females give birth to their single pup in May and June of each year (Tibbitts pers. comm.). The mine consists of a single horizontal tunnel, open at both ends, that is 254-m long, 2-m high, and 1.5-m wide (Fleming et al. 1998).

Bluebird Mine Maternity Roost – In the past, the Bluebird Mine at Cabeza Prieta NWR has been an important roost for small populations of *L. curasoae* in late spring and summer each year (Petryszyn and McCasland pers. comm.). In recent years the Bluebird Mine has been utilized as a drug drop-off area for drug trafficking or shelter for undocumented aliens (UDA's). The bats did not use the mine during the time that the other activities were present. Employees with the U.S. Fish and Wildlife Service installed a large metal gate around the entrance of the mine several years ago that discouraged the use of the mine to undesirable drug activity or for UDA's. The bats began using the roost again after the gate was installed (McCasland pers. comm.). In 2005, it appeared that the UDA's and



Figure 1:Curt McCasland removing bats from harp trap.

possibly drug runners were once again using the mine to hide out in or to store drugs (McCasland pers. comm.). For 2005, we netted bats at the Bluebird Mine at an adit above the main roost.

A total of 50 *L. curasoae* were netted at the Copper Mountain roost at ORCNM in July and August 2005 (Tables 2 - 4). Our USFWS permit allowed us to mark a total of 170 bats with radio transmitters (15 bats) and micro-chips (155 bats) at two different roosts. We netted a total of 38 bats and marked 12 bats (2 radios, 10 TAGs) at the Bluebird Mine at Cabeza Prieta NWR on July 24, 2005 (Table 1). Twenty-three additional bats were marked at the Copper Mountain roost on July 30-31 and August 1, 2005 (Table 2, 3, 4). Fourteen bats were marked with micro-chips with reflective tape (yellow color) and nine bats marked with radio transmitters (Table 2, 3, 4). All markers were glued to the back of the bats with skinbond surgical adhesive. Radio transmitters were placed on both adult (females) and young of the year (males and females) *L. curasoae* (Table 1-4). We were authorized to implant micro-chips to 20 of the bats but did not do so because the majority of the bats that we netted were young of the year. The weights for the 11 females (Table 1-4) fitted with radio transmitters ranged from 22 grams to 28 grams (average weight was 23.9 grams). The radio transmitters weighed 0.60 grams (1) and 0.75 grams (10). All markers placed on the backs of adult females and juveniles were well under the recommended 5 % of the body mass of the bat. We recorded GPS coordinates for all of the netting sites.

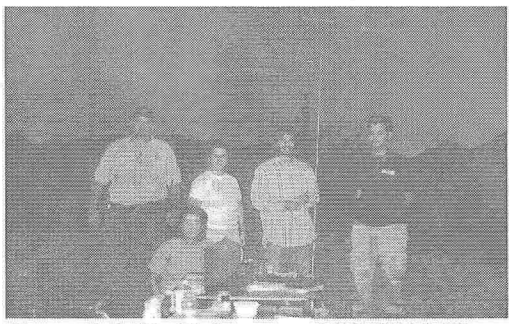




Figure 2 (left): Field crew at OPCNM (Guy, Antje, Adam, Keno, and Ami is seated).
Figure 3 (right): Field crew at OPCNM (Karen, Angie, Alicia, Guy, Ami, Adam, and Antje).

At the Copper Mountain roost on July 30-31, 2005, we set up three nets each evening and one net on August 1, 2005. We used 2.4 m, 6 m, and 9 m nets to catch the bats (Table 2-4). All nets were set up outside the south exit of the Copper Mountain roost and from 30 meters to 61 meters from the roost. At the Bluebird Mine we set the harp trap directly in front of the adit roost exit and the net 6 meters from the harp trap (Table 1, Figure 1). We carefully chose distances and areas from the roosts so we could avoid capturing too many bats at one time. During the netting, we continuously monitored nets, immediately removed bats, and closed nets appropriately to avoid having to handle excessive number of bats. Bats were handled and marked by experienced biologists (Karen Krebbs, Curtis McCasland, Ami Pate, Angie McIntire, Alicia Sweezer, Keno Larios). Captive bats were placed in individual cloth bags, in order to minimize their movements and prevent injury. Data (Table 1-4) were recorded on age, sex, general body

condition and body mass, and bats were then marked (radio transmitters, micro-chips with reflective tape).

We collected genetic samples from 69 *L. curasoae* (as per USFWS permit) during the marking sessions at the Copper Mountain roost (Table 2-4) and the Bluebird Mine by rubbing the swab on the inside of the bats' mouth to collect the DNA. The nectar bats often licked and bit at the swab, unlike the captive *M. californicus* that we had first tested the technique on in 2004. The swab was then placed in a sterile alcohol container. The mouth swabs were turned over to Dr. Melanie Culver at the University of Arizona for DNA extraction and sequencing.

Radio telemetry field data collection – Eleven (10-0.75 gram and 1-0.60 gram) Holohil BD-2 transmitters were attached with Skinbond adhesive on July 24, 30, 31 and August 1. The bats were released as soon as the adhesive was dry. Transmitters were attached (Tables 1-4) to five adult post-lactating females (average weight 23.6 grams), three were attached to juvenile males (average weight 23 grams), and three attached to juvenile females (average weight 25 grams). Signals were tracked with 3 and 5-element Yagi directional antennas mounted on a 2-meter aluminum pole and we also utilized hand-held antennas. The free-turning pole, with Silva compass attached for recording bearing data, was anchored with a Bogen tripod, or PVC tube in rock cairn. Communication Specialists, Inc. R-1000 radios were used to receive signals. When utilizing the hand-held antennas the Silva compass was not attached to the antenna.

We checked for signals intermittently on July 24, 30, 31, and August 1 while radio tagging, attaching micro-chips, and collecting DNA during the fieldwork at the Copper Mountain and Bluebird roost. We were not allowed to carry out additional radio telemetry work at the Copper Mountain roost due to the increased drug trafficking activity in this area. We also were not able to return to the Bluebird Mine due to schedules and UDA activity in that area.



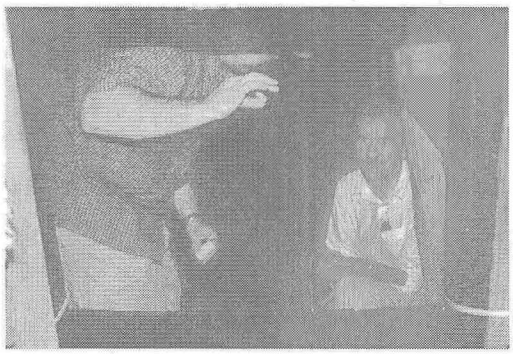


Figure 4 (left) & 5 (right): Tim and Nicki hiking to roost with battery and customized antenna. Brian explains the chip technology to Tim at the Copper Mountain roost. The antenna is attached with plastic ties to the wooden frame at the south entrance door of the mine.

PIT Monitoring Antenna System – Biomark constructed a 0.76 m X 0.91 m (2.5'X 3.0 ') pass-through antenna that was attached to the wooden frame at the south entrance of the Copper Mountain Mine. The antenna was configured to work with the micro-chips

that we would be placing on the bats. We estimated flight speed for the bats passing through the antenna for proper detection once the antenna was working. There was no available power at the mine so 12-volt batteries were used to power the antenna. A reader was attached to the antenna and data collected as bats flew through the antenna when exiting or entering the mine through the south entrance. A tuning box allowed adjustments of the antenna readings. The reader was housed in a plastic box (with a cover) to protect it from the weather and other wildlife. A representative from Biomark (Brian Beckley) helped us install the antenna at the roost a week before the marking fieldwork began. The antenna system was tested at the time of installation (July 18, 2005) and then turned off (Figure 5). The antenna was not turned back on until we marked the first bats (July 30) at the Copper Mountain roost for this project. The micro-chip reader, antenna, and batteries were utilized and maintained by National Park Service Biologists during the month of August at the Copper Mountain roost (Figure 4). The 12-volt batteries had to be removed after five to six days and replaced with a charged battery. The reader data was downloaded at a later time for analysis (Table 10).

Fieldwork – Southeastern Arizona

We began looking for bats in southeastern Arizona in August. We checked roosts in the Patagonia Mountains (Patagonia Cave), Huachuca Mountains (State of Texas Mine, Pyeatt Cave {Ronnie Sidner}), Chiricahua Mountains (Hilltop and Buckelew Mines), and utilized radio telemetry equipment in the Chiricahua, Patagonia, Huachuca, Whetstone, Mustang, Dragoon, Dos Cabeza, Catalina, Rincon, and Tucson Mountains (Table 6). At the Patagonia Cave, State of Texas Mine, Pyeatt Cave (Sidner), Hilltop Mine, and Buckelew Mine we utilized equipment (radio telemetry, video cameras with IR lights, night-vision goggles) outside the roosts to search for the marked bats. Roosts and mountains were monitored for marked bats throughout the month of August (Table 6). We did not continue our searches beyond this time (August) because of the short-duration life of the glue (skinbond adhesive) used to adhere the markers to the bats and the battery life of the radio transmitters (28 days).



Figure 6: *L. curasoae* with micro-chip and reflective tape glued to the back.

Equipment

Equipment used for the fieldwork included Sony video camera (Model DCR-TRV350), IR Lights (Dalton), Litton Night-Vision Goggles (Model M973), Garmin GPS map 60 CS, Radio Telemetry Unit (Holohil Systems, Ltd.), PIT TAG (Biomark, Inc.), PIT TAG Reader and Antenna (Biomark, Inc.), Kestrel Weather Instrument, Mist Nets (Avinet, Inc.), Canon Digital Camera, and Minolta 35 mm camera. The special antenna was designed and installed at the roost by Biomark (Brian Beckely).

RESULTS

Fieldwork – Southwestern Arizona (Copper Mountain and Bluebird Mine)

A total of 35 bats were marked with radio transmitters (11 bats) and micro-chips with reflective tape (24 bats) in July and August 2005 (Table 1- 4). All bats marked were captured in nets (both Copper and Bluebird Mine) and one harp trap (Bluebird Mine) placed outside the south exit of Copper Mountain roost at OPCNM and an adit above the Bluebird Mine roost. During the marking sessions we searched for bats with the telemetry equipment at the Copper Mountain and Bluebird Mine while we continued to mark additional bats. We utilized radio telemetry equipment, video cameras with IR lights, night-vision goggles, and micro-chip reader and antenna to search for marked bats.

Of the nine radio-tagged bats marked at OPCNM, six were detected throughout the marking sessions (July 30-31 and August 1). Four of these bats (# 758, # 241, # 210, # 118) immediately returned to the roost after they were marked and two left the roost again (south entrance) within an hour of their return (Table 8). Once the two bats (# 286, # 312) were marked with radio transmitters at the Bluebird Mine, they flew away from the roost and did not return while we continued marking other bats with micro-chips (Table 8). Unlike 2004, we were not permitted to set up radio tracking stations at the Copper Mountain roost or in the surrounding areas at OPCNM due to the drug problems in these areas. We were also not permitted to return to this roost to videotape or observe the exit flight with night-vision goggles. Our access at the Copper Mountain roost was limited to the three evenings that we marked bats.



Figure 7: *L. curasoae* with radio transmitter in southwestern AZ.

Four of the nine bats (# 191, # 142, # 100, # 080) marked with transmitters at OPCNM immediately flew to the southeast and away from the roost. One bat (# 758) flew to the roost and then came back out of the roost (30 minutes later) and headed southeast. Another bat (# 118) exhibited the same behavior (returning to the roost) but moved northeast after exiting the roost nine minutes later (Table 8). One bat (# 171) flew northeast after being marked (Table 8). Since we were monitoring marked bats during the marking session, we could have missed some of the radio signals from released bats when we were busy handling other bats.

The netting session at the Copper Mountain roost worked out well and we obtained excellent biological information on both adult females and young of the year (Table 2, 3, 4). We were never overwhelmed with more bats than the bat handlers (Karen K., Ami P., Angie M., Alicia S., Keno Larios) could manage. We closed the nets several times during the evenings for the netting sessions to avoid capturing too many bats. The netting session at the adit above the Bluebird Mine worked well with one net and the harp

trap (Table 1 and Figure 1). We handled a total of 88 bats at the two roosts and had no deaths or injuries.

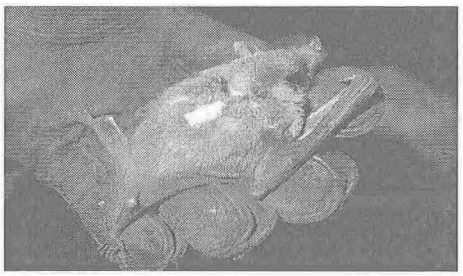


Figure 8: Preparing bat for micro-chip.

The customized antenna built by Biomark in 2005 detected five of the fourteen bats marked with micro-chips at OPCNM. All five of the bats detected were juveniles (3 males, 2 females) and born in 2005. The few adults we captured were marked with radio transmitters so the majority of the micro-chips were placed on young bats. Two of the bats were detected for more than one day (# 79, # 119) and two bats (# 23, # 79) detected more than once for a given day (Table 10). One bat (# 79) was detected three times on one day and five times on another (Table 10). We were not able to determine if the bat was flying into or out of the roost but some of the bats flew through the antenna up to five times in an evening. Since the antenna was installed at the south entrance of the mine, we do not know if some of these bats used the north entrance but they most likely used both at some time or another. It would be normal for an adult female caring for a pup to make several trips in and out of the roost to nurse her young but we lack information on the behavior of young bats (less than a year) at roosts like Copper Mountain. The antenna readings illustrated that some of these young bats are flying in and out of the roost more than once on a nightly basis. Bat # 79 flew through the antenna three times during one evening with only one and two minute intervals (Table 10) between the readings. Another young bat (# 119) flew through the antenna one time for each of four evenings. This particular bat must have exited or entered the mine through the north entrance the other times since the antenna did not detect the bat for a second time for those evenings. Two other bats (# 54, # 106) displayed similar behavior and were only detected one time for each evening they were detected. All three males (# 54, # 106, # 119) were only detected one time for each of the evenings whereas the two females (# 23, # 79) were detected from two to 5 times for a given evening. It would have been interesting if we had obtained more data from the micro-chips had we been allowed to mark more bats. All of this data is new and fascinating for this species of bat.

We made the decision to mark individuals based on age, weight, and general physical condition of the bat. We did not want to mark young bats that had just learned to fly (or leave the roost) or adult females that were still lactating. We were unable to implant micro-chips to any of the adult bats (as per our USFWS permit) since most of the adult females had left the roost at the time of marking (July 30, 31 and August 1). The few adult females that we captured were marked with radios. We did not net any females that were still lactating (Table 1-4). After all the bats had left the roost for the year, NPS Biologists entered the roost and found four of the micro-chips on the floor of the mine. These markers had fallen off the bats but indicated that bats had returned to the roost after being handled and marked. Our radio telemetry efforts also indicated that marked bats (4) returned to the roost after they had been marked.

Fieldwork – Southeast Arizona

We began our search for marked bats in southeast Arizona the first week of August (Table 6). During the month of August, we checked the State of Texas Mine, Pyeatt Cave, Patagonia Cave, Hilltop Mine, and Buckelew Cave in the Huachuca, Patagonia, and Chiricahua Mountains for marked bats utilizing night-vision, video camera, and radio telemetry (Table 6). We also set up the radio telemetry equipment on or near the Chiricahua, Huachuca, Patagonia, Dragoon, Mustang, Whetstone, Tucson, Dos Cabeza, Rincon, and Catalina Mountains in addition to observation sites at Kino Springs, Canelo Hills, and the Vail (Cienega Creek) areas (Table 6). We carried out 118 hours of telemetry work during 29 evenings of fieldwork during August. We would have had an additional two evenings of telemetry work for August had it not rained.

Micro-chip reader/antenna – Unlike 2004, the micro-chip reader/antenna was not set up outside the roosts in southeastern Arizona. For 2005, we wanted to test a new customized antenna at the Copper Mountain Mine roost Figure 4 & 5) and could not remove the antenna for use elsewhere. When the 12-volt battery was exchanged on a weekly basis, we observed a great deal of *L. curasoae* bat guano on the exterior surface of the antenna covering and concluded that the bats were flying through the antenna at the roost. We were unable to videotape the bats exiting the south entrance of the roost due to the drug trafficking problem at ORPI during out fieldwork.

Radio Telemetry – We utilized the radio telemetry equipment at the State of Texas Mine (Huachuca Mountains), Pyeatt Cave (Huachuca Mountains), Hilltop Mine (Chiricahua Mountains), and Patagonia Cave (Patagonia Mountains) to search for marked bats. The telemetry antenna was set up outside of these roosts and was usually placed 9-15 meters from the roost exit. We also utilized the telemetry equipment on several hilltops in the Chiricahua, Huachuca, Patagonia, Mustang, Dragoon, Whetstone, Rincon, Tucson, Catalina, and Dos Cabeza Mountains (Table 6). On August 21, 2005 we located one of our marked bats (# 118) near the Mustang Mountains. On August 24 and 27th, 2005 we detected this same bat again near the Whetstone Mountains. This female was originally marked at ORPI on July 31, 2005 (Table 5). The Mustang Mountains are located about 228 kilometers and the Whetstone Mountains 243 kilometers southeast of the Copper Mountain roost where these females were originally marked. We did not locate any other marked bats with the telemetry equipment in any of the other mountain ranges in southeast Arizona or from the Bluebird Mine at Cabeza Prieta National Wildlife Refuge.



Figure 9 (left) & 10 (right): Bob and Anne Graf setting up telemetry near Mustang Mountains. Antje Adams scanning for marked bats in the Dragoon Mountains.

Night-Vision Goggles/Video Cameras – We utilized the night-vision devices and the video cameras at the State of Texas Mine, Patagonia Cave, Hilltop Mine, Buckelew Mine, and Pyeatt Cave roosts to search for marked bats. We did not observe any of the bats (with micro-chip and reflective tape) at the above roosts that had been originally marked in southwestern Arizona.

DISCUSSION

In the Americas, nectar-feeding bats are a diverse group comprising 36 species that mainly inhabit arid and semiarid lands (Koopman 1981, Valiente-Banuet et al. 1996a,b, Arita and Santos del Prado 1999). Nectar-feeding bats of the family Phyllostomidae (subfamily Glossophaginae) are known to pollinate the flowers of over 270 genera and 750 species of neotropical plants (Heithaus 1982, Dobat 1985). In North America, seasonal movements of *Leptonycteris curasoae* follow the flowering patterns of the plants that the bat consumes (Cockrum 1991, Fleming et al. 1993a, Fleming 1995, Krebbs and Hubbard 2004). Cacti and agaves comprise much of the diet of nectar bats. The conservation of nectar corridors for *L. curasoae* not only benefits this species, it also helps a wide variety of other species that are in some way dependent on cactus or agaves (Fleming 2004).

Leptonycteris curasoae barely reaches the United States after migrating north from central Mexico (Fleming 2004). This species forms maternity colonies in southwestern Arizona and northern Mexico in the spring and either migrates back down to Mexico afterwards or to the southeastern mountains of Arizona to forage on the abundant agave. The bats forage along "latitudinally broad paths of blooming plants" as they migrate between their winter and summer habitats (Fleming et. al. 1993). One of the goals of the ASDM's Migratory Pollinator Program (MPP) is to identify migration corridors for *L. curasoae* from Jalisco to Arizona. Results from earlier studies (Wilkinson and Fleming 1996, Ceballos et al. 1997) on carbon stable isotope analysis and mitochondrial analysis indicated the migration routes of *L. curasoae* from Mexico to Arizona. However, we know little about post-maternity movements from roosts in southwestern Arizona.

Data from previous studies indicate that in the spring *L. curasoae* utilizes crassulacean acid metabolism (CAM) plants like columnar cacti and then Calvin (C3) plants such as the paniculate agaves in late summer. The flowering phenologies and geographic distributions of these columnar cacti and paniculate agaves suggest that the bats migrate in and out of the Sonoran Desert along two different nectar corridors: a coastal cactus corridor in the spring and an inland agave corridor in the fall. Other data (Medellín pers. comm.) indicate that separate western coastal and inland mountain corridors exist, but there are also data that support sharing of corridors over a strict separation. Members of these populations may "jump" from the western corridor to the eastern (inland) corridor in Arizona. This may indicate that not all *L. curasoae* leave the maternity roosts in late summer to return to Mexico but some may travel to southeastern Arizona to forage on the abundant agave. During ASDM's MPP, Ted Fleming and

ASDM collected tissue samples from *L. curasoae* at the State of Texas Mine in the Huachuca Mountains. After analysis, the data indicated that the population of *L. curasoae* in southeastern Arizona came from central Mexico (inland agave corridor) and not from Jalisco (coastal cactus corridor). These patterns emerged from an analysis of tissue samples from only 49 individuals, which attests to the power of genetic analysis for discerning large-scale movement patterns (Fleming 2004).

For this study (2004-2005), DNA cheek samples were taken from 140 bats at the Copper Mountain and Bluebird Mine roosts. These are bats that travel the coastal cactus corridor. We were authorized to collect DNA cheek samples from up to 220 bats but did not get the opportunity to handle that many *L. curasoae* in 2005. Dr. Melanie Culver (University of Arizona) is analyzing the DNA samples but we have no information on these data at this time. We utilized cheek swabs for the DNA collection instead of the common wing punches that have been used in the past. This new technique for collecting DNA worked very well on *L. curasoae.* Dr. Culver was able to extract DNA from the captive bat *(M. californicus)* samples (2004) with the cheek swab technique and it is hoped that the samples from *L. curasoae* (2004-2005) will be as successful.

Two bats that were marked at the Copper Mountain roost on July 31, 2005 were later located with radio telemetry near the Mustang and Whetstone Mountains (21, 24, 27, and 29 days later). We did not think the radio transmitters would be useful in locating marked bats in southeastern Arizona because of the short battery life (~ 28 days). Timing was crucial when marking the bats to maximize the battery life of the transmitters. During the two years of study (2004-2005), locating marked bats in southeastern Arizona indicates that at least three of the marked individuals moved east from the maternity roost in southwestern Arizona to the southeastern corner of the state. This is crucial information on the movements of *L. curasoae* within Arizona. Biologists have suspected that some of the bats were moving east to take advantage of the rich nectar of the agave plants in the mountains of southeastern Arizona. This is the first evidence that *L. curasoae* may "jump" from the western corridor (coastal cactus) to the eastern corridor (inland agave) in Arizona. In 2005, we had hoped to mark a total of 170 bats (as per our USFWS permit) but were unable to carry out our goal because of the numerous problems (drugs, UDA's) that exist along the border of Arizona. Instead, we marked a total of 35 bats giving us a much smaller sample size (statistically insignificant) for this years' study. Despite these setbacks, we were able to locate a few of the marked bats (significant information) in southeast Arizona. One of the females located in southeast Arizona in 2005 was a young bat (2005 birth) and indicates that a first year female migrated east before moving back to Mexico for the winter. We also marked three young males (2005 birth) but did not detect any males in southeastern Arizona for this project. If we had been able to mark a total of 170 bats this year we might have detected more of our marked bats in southeast Arizona.

The radio telemetry was also utilized to find out if marked bats were jumping from one roost to another in southwestern Arizona. We did not locate any of the marked bats at other roosts in southwestern or southeastern Arizona, other than the bats we located in the Patagonia (2004), Mustang (2005), and Whetstone (2005) Mountains. We

were not permitted to follow the nine bats marked with radio transmitters at ORCNM in 2005 as we did in 2004. Our tracking efforts (after the marking) were discouraged by the NPS Law Enforcement Officers and the U.S. Border Patrol at OPCNM. In 2004, we not only determined that marked bats were returning to the roost but also obtained some excellent information on foraging. We also located five micro-chips on the floor of the Copper Mountain roost at the end of the season indicating that marked bats returned to the roost afterwards.

In 2004, OPCNM experienced a drastic 90% failure of saguaro-organ pipe flowers and fruit (Tibbitts pers. comm.) during the time that *L. curasoae* are dependent (or so we thought) upon this food source. Roost exit counts were surprisingly high and it was obvious that *L. curasoae* had located other food sources to replace the saguaro and organ pipe cactus (Figure 13 & 14). Bat exit counts at the Copper Mountain roost for 2005 were also high and there appeared to be no observable ill effects of the flower/fruit failure for 2004 (Figure 13 & 14). *Leptonycteris curasoae* is probably more resilient to flower and fruit failures than we have given them credit for in the past. If pressed to fly further distances to find food, they are definitely capable of doing that.

From the beginning, this project has gone through many changes (i.e.-wristbands, necklaces) to determine the best and least harmful marking technique for *L. curasoae* (Krebbs et. al. 2005). Discussions with Dr. Rodrigo Medellín and others indicated that both wristbands and necklaces as a marking technique for *L. curasoae* were not desirable for this species. Wristbands cause irritation and injuries for many species of phyllostomids. Dr. Medellín indicated that the *L. curasoae* netted after being marked with necklaces in Mexico, had injuries from their necklaces. Other marking techniques, like the micro-chip (PIT Tags), needed to be tested and developed (this two-year project). In an era of advanced technology, computer chips are making it possible to follow smaller organisms (without adding the burden of weight) and offer a more optimistic future for increasing knowledge. The computer chip technology has advanced but the technology to detect the chips (i.e. antenna) is still developing. This type of antenna is also expensive and many biologists may not have the funds to utilize such a system. We glued micro-chips with reflective tape on the backs of three *M. californicus* in our captive study (Krebbs et. al 2005) and 84 *L. curasoae* bats in the field during the two-year study. The chip could be recognized with the night-vision, video cameras, and bright light for the captive study and in the field. The micro-chip antenna that was utilized in the field for 2005 was not portable and we couldn't move it from roost to roost. The antenna detection system for this year's study was more advanced than that of 2004 but we were only able to test this antenna at the one roost (Copper Mountain). The small triangular antenna we utilized in 2004 required the bats to fly within 30-38 centimeters (12-15 inches) for detection. Flying within 30-38 centimeters of the antenna seemed no problem for most of the bats but we did not detect any bats with this antenna in 2004.

The customized antenna was experimental in 2005 but very successful for our purposes in the field. The antenna detected five of the bats marked with micro-chips. All the bats detected with this system were bats that had been marked at the Copper Mountain roost. We had hoped that some of the marked bats from the Bluebird roost

would appear at the Copper Mountain roost but we have no evidence that this occurred during this study. The bats may be moving between roosts in southwestern Arizona but we could not determine that with this two-year study. Micro-chips are implanted under the skin of the back of an animal and is a common technique for mammals, reptiles, fish, and some birds. This technique is used on both captive and wild animals and a hand-held reader (or antenna) can be utilized to read the chip. A study in Fort Collins (O'Shea et al. 2003) on *Eptesicus fuscus* has utilized the implanting technique for several years. We did implant captive insectivorous bats with micro-chips at ASDM before the field season. We did not obtain permission from USFWS to implant the chips to *L. curasoae* until the 2005 field season. Due to a two-week delay in 2005 to our field season, no micro-chips were implanted in adult females as planned. Once a bat is implanted with the chip it will carry this marker for the life of the animal. If we had been able to carry out our goal of implanting 20 bats we could have checked for marked bats at the roost in future years.

The difficulties of studying an endangered species are many. Obtaining permits to work with this species can be difficult and time consuming to maintain. Agency permission must be obtained to work at these locations. Working along the border of Mexico can be dangerous. For this project, timing was crucial to maximize glue and battery life of the radio transmitters. The delay in the onset of the marking of the bats resulted in less adult females being marked in 2005. The adult females leave the roost for other foraging areas in Arizona or Mexico during the latter part of the summer and before the sub-adults leave. Preparation time for a project of this caliper is immense.

More than 100,000 *L. curasoae* migrate to southern Arizona and northern Mexico each spring to have their young. Once the young are volant there are many more *L. curasoae* in Arizona and northern Mexico (personal observation) during the late summer. Trips made to the Pinacate roost over the past two years indicated that there were more than the estimated 100,000 bats exiting this one roost. At this time the young had been weaned (and were volant) and numerous bats were using this particular roost (personal observation). Looking for a small number of marked bats among thousands is difficult to say the least.

It is encouraging and exciting that we located marked bats in southeastern Arizona (211, 228, and 243 km east of OPCNM) when we only marked 106 bats for the two-year project. It's equally exciting to have detected five bats with the experimental customized antenna. The customized antenna that Biomark designed for our use worked very well and should be further developed to aid in the study of bats. Bats marked with the micro-chips and radio transmitters were tracked or detected at the roost. The handling of these bats did not discourage them from returning to the roost or continuing their activities. We handled a total of 206 bats for the two-year study and had no deaths or injuries. Future research should include marking additional bats and the development of new technology (micro-chip) to search for them. In 2005, we focused on marking *L. curasoae* with micro-chips with reflective tape, radio transmitters, and collected DNA cheek samples from the bats in southwestern Arizona. We then looked for the marked bats in southeast Arizona. We accomplished the majority of our goals for this project and detected marked bats in both southwest and southeast Arizona despite the difficulties of

working along the border of Arizona. Future research on *L. curasoae* movements within the state should consider the serious problems and dangers associated with drug trafficking and the illegal entry of aliens into the United States. Can the pursuit of additional natural history knowledge of *L. curasoae* within Arizona be balanced with agency difficulties and decisions? We hope that the important research for this species of bat continues in Arizona and that the border issues do not impede our quest for additional knowledge or hamper recovery efforts of this endangered species.

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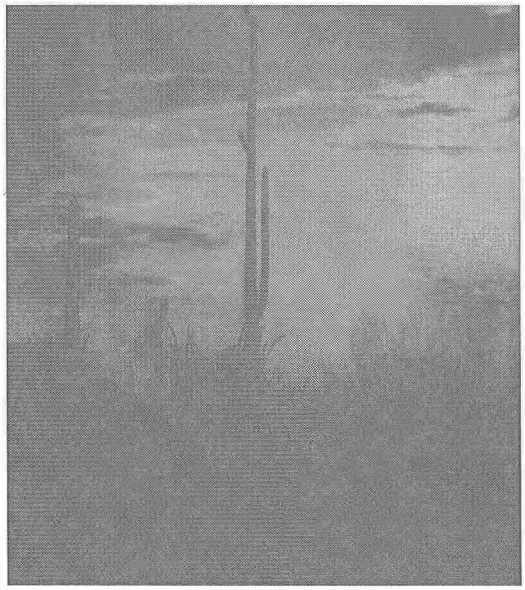
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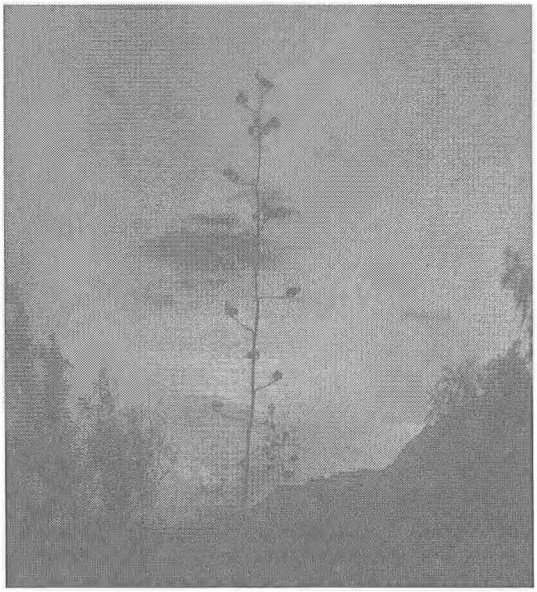


Figure 11 & 12: Sunsets at Organ Pipe Cactus National Monument (left) and southeast Arizona (right).

APPENDIX

2005 FIELD DATA TABLES, MAPS, AND FIGURES

Karen Krebbs

Table 1: Bat netting data from the Bluebird Mine at Cabeza Prieta NWR on July 24, 2005. One 8' (2.4 m) net and one harp trap set up outside mine adit and entrance of adit on slope above main mine roost. Weather @ 2238 hours: Wind 4.0 mph), cloudy, temp (86.1 F), humidity (55 %), dew point (67.8 F); Biologists – Karen Krebbs, Curtis McCasland, Antje Adams; *Le = Leptonycteris curasoae;* M = male; F = Female; SP = Species; H = Harp trap; 1 = 8' net; Juv = 2005 Juvenile; Adt = Adult; WT = Weight in grams; SWAB = DNA sample collected; RAD = Radio transmitter and frequency; PIT = micro-chip and number; Mites = insects on bat; Post lac = female with nipples present but not lactating; UKN = Unknown sex; Escaped = bat escaped before processing was complete;

NET	TIME	SP	SEX	AGE	WT	PIT	RAD	SWAB	NOTES
H	2016	*Le*	M	Juv	22.5	11		1	Mites
H	2016	*Le*	F	Juv	20			2	Mites
H	2016	*Le*	M	Juv	20			3	Mites
H	2017	*Le*	M	Juv	19			4	Mites
H	2020	*Le*	F	Juv	21			5	Mites
H	2022	*Le*	F	Juv	20	38		6	Mites
H	2022	*Le*	F	Juv	23			7	Mites
1	2025	*Le*	----	Juv	----				Escaped
H	2038	*Le*	F	Juv	21			8	Mites
H	2038	*Le*	M	Juv	25			9	Mites
H	2038	*Le*	F	Juv	23			10	Mites
1	2048	*Le*	F	Adt	23			11	Post lac; mites
1	2048	*Le*	F	Juv	21			12	Mites
1	2055	*Le*	M	Juv	20			13	Mites
H	2056	*Le*	M	Juv	21	64		14	Mites
H	2103	*Le*	F	Juv	22			15	Mites
H	2104	*Le*	F	Juv	20			16	Mites
H	2105	*Le*	F	Juv	21				Escaped
1	2107	*Le*	M	Juv	19			17	Mites
H	2108	*Le*	F	Juv	21			18	Mites
H	2108	*Le*	F	Adt	24			19	Post lac; mites
H	2113	*Le*	M	Juv	23			20	Mites
H	2115	*Le*	F	Adt	24			21	Post lac; mites
H	2124	*Le*	M	Juv	19			22	Mites
H	2124	*Le*	F	Adt	24		312	23	Post lac; mites
H	2128	*Le*	F	Adt	25		286	24	Post lac; mites
H	2133	*Le*	M	Juv	22			25	Mites
H	2134	*Le*	F	Juv	20			26	Mites
H	2141	*Le*	M	Juv	19				Mites

Table 1 continued									K. Krebbs
1	2151	*Le*	F	Juv	24				Mites
1	2154	*Le*	F	Juv	18	104			Mites
1	2200	*Le*	----	Juv	----				Escaped
H	2207	*Le*	M	Juv	23	77			Mites
H	2207	*Le*	F	Juv	18	37			Mites
H	2223	*Le*	F	Juv	23	63			Mites
H	2227	*Le*	F	Adt	29	7			Post lac; mites
H	2232	*Le*	M	Juv	24	151			Mites
H	2235	*Le*	F	Juv	24	109			Mites
Total		38 Bats	13 M 23 F 2 Uk	6 Adt 32 Juv		10 PIT	2 RAD	26 SWAB	

Table 2: Bat netting data from the Copper Mountain Mine at Organ Pipe Cactus National Monument (OPCNM) on July 30, 2005. Two 20' # 1 & # 2 (6 m) nets and one 30' # 3 (9 m) net set up outside south entrance of mine at ORPI. # 1 & # 2 nets were closest to roost entrance and # 3 net furthest from roost entrance. Weather @ 1905 hours: wind (2.0 mph), cloudy, temp (84.2 F), humidity (64 %); 2300 hours: wind (0 mph), temp (78.6 F), humidity (78 %); Biologists – Karen Krebbs, Ami Pate, Antje Adams, Angie McIntire, Alicia Sweezer, Adam Hinckle; See abbr. in Table 1.

NET	TIME	SP	SEX	AGE	WT	PIT	RAD	SWAB	NOTES
2	2025	Lecu	M	Juv	22			27	Mites
2	2042	*Lecu*	M	Juv	23			28	Tumor on nose
2	2043	*Lecu*	M	Juv	23	6		29	
2	2046	*Lecu*	F	Juv	21			30	
2	2048	*Lecu*	M	Juv	19			31	Mites
2	2048	*Lecu*	M	Juv	---				Left eye clear; bat released
2	2048	*Lecu*	M	Juv	20			32	Mites
3	2050	*Lecu*	M	Juv	19			33	
3	2051	*Lecu*	F	Juv	24	71		34	Mites
2	2055	*Lecu*	M	Juv	23	25		35	Mites
1	2100	*Lecu*	F	Juv	21				
3	2100	*Lecu*	F	Adt	---				Bat released
2	2100	*Lecu*	M	Juv	---				Small particle in eye & removed; bat released
2	2102	*Lecu*	F	Juv	21	33		36	Mites
2	2108	*Lecu*	F	Juv	23	23		37	Mites
2	2116	*Lecu*	M	Juv	20			38	Mites
2	2145	*Lecu*	M	Juv	20			39	Mites
2	2148	*Lecu*	M	Juv	22	106		40	Mites
2	2228	*Lecu*	M	Juv	23		758	41	
Totals		19 Bats	13 M 6 F	1 Adt 18 Juv		6 PIT	1 RAD	15 SWAB	

Table 3: Bat netting data from the Copper Mountain Mine at Organ Pipe Cactus National Monument (OPCNM) on July 31, 2005. Two 20' # 1 & # 2 (6 m) nets and one 30' # 3 (9 m) net set up outside south entrance of mine at ORPI. # 1 & # 2 nets were closest to roost entrance and # 3 net furthest from roost entrance. Weather @ 1912 hours: wind (1.1 mph), cloudy, temp (87.4 F), humidity (55 %); 2110 hours: wind (.7 mph), temp (85.2 F), humidity (64 %); Biologists – Karen Krebbs, Ami Pate, Antje Adams, Keno Larios, Adam Hinckle; Nets opened @ 1945 hours and closed @ 2300 hours. See abbreviations in Table 1.

NET	TIME	SP	SEX	AGE	WT	PIT	RAD	SWAB	NOTES
1	1919	*Lecu*	F	Juv	23.5		241	42	Mites
3	1920	*Lecu*	F	Juv	21			43	Mites
2	1928	*Lecu*	M	Juv	22			44	Mites
2	1932	*Lecu*	M	Juv	23	114		45	Mites
2	1935	*Lecu*	M	Juv	21			46	Mites
2	1936	*Lecu*	M	Juv	20			47	
2	1938	*Lecu*	F	Juv	20			48	Mites
1	1939	*Lecu*	F	Juv	24		210	49	Mites
2	1943	*Lecu*	F	Juv	24	1		50	Mites
1	1948	*Lecu*	F	Juv	22			51	Mites
3	1951	*Lecu*	F	Adt	22		191	52	Post lac; mites
2	1954	*Lecu*	F	Juv	22.5	79		53	Mites
1	1954	*Lecu*	M	Juv	---			---	Released
2	2000	*Lecu*	F	Juv	20			54	Mites
2	2001	*Lecu*	M	Juv	19			55	Mites
1	2002	*Lecu*	F	Juv	22	111		56	Mites
1	2004	*Lecu*	M	Juv	22.5	54		57	Mites
2	2005	*Lecu*	M	Juv	---			---	Released
2	2012	*Lecu*	M	Juv	22	85		58	Mites
3	2014	*Lecu*	M	Juv	23		171	59	Mites
1	2016	*Lecu*	F	Adt	23			---	***Post lac; escaped***
2	2058	*Lecu*	F	Juv	18			60	Very young bat!
2	2059	*Lecu*	M	Juv	23.5		142	61	Mites
2	2101	*Lecu*	M	Juv	21			62	Mites; escaped
3	2106	*Lecu*	F	Adt	24		118	63	Post lac; mites
3	2128	*Lecu*	F	Juv	28		100	64	Mites
2	2129	*Lecu*	F	Juv	21			65	Mites
2	2131	*Lecu*	F	Juv	19.5			66	Mites
Total		**28 Bats**	**12 M 16 F**	**3 Adt 25 Juv**		**6 PIT**	**7 RAD**	**25 DNA**	

Table 4: Bat netting data from the Copper Mountain Mine at Organ Pipe Cactus National Monument (OPCNM) on August 1, 2005. One 20' (6 m) #1 net set up outside the south entrance of mine at OPCNM. Weather @ 1846 hours: wind (0.6 mph), cloudy, temp (75.8 F), humidity (78 %); 2151 hours: wind (0 mph), temp (71.8 F), humidity (95 %); Biologists – Karen Krebbs, Antje Adams, Adam Hinckle; Net opened @ 1942 hours and closed @ 2230 hours. See abbreviations in Table 1.

NET	TIME	SP	SEX	AGE	WT	PIT	RAD	SWAB	NOTES
1	2057	*Lecu*	F	Adt	23		080	67	Mites; Post lac
1	2107	*Lecu*	M	Juv	22	80		68	Mites
1	2139	*Lecu*	F	Juv	20	58		69	Mites
Total		3 Bats	1 M 2 F	1 Adt 2 Juv		2 Pit	1 RAD	3 DNA	

Table 5: Data on *L. curasoae* marked in southwestern Arizona in 2004-2005 and later detected in southeastern Arizona. LOC MRK = Location bat marked in southwest AZ.; LOC DET = Location bat detected in southeast AZ.; DATE MRK = Date bat marked in southwest AZ.; DATE DET = Date bat detected in southeast AZ.; F = Female; WT = Weight in grams; RAD = Radio transmitter and frequency (150.#); Cu Mtn = Copper Mountain Mine; Pat Mtn = Patagonia Mountains; Must Mtn = Mustang Mountains; Whet Mtn = Whetstone Mountains; SE = Southeast; SW = southwest; NW = Northwest; Adt = Adult; Juv = Juvenile 2005 birth; Mtns = Mountains; AZ = Arizona; # KM = Approximate kilometers from marking location or roost in southwestern AZ to area bat was detected in southeast AZ.;

LOC MRK	DATE MRK	SEX	AGE	WT	RAD	LOC DET	DATE DET	# KM	NOTES
Cu Mtn	7/20/04	F	Adt	22	# 329	Pat Mtn	8/10 '04	211	Bat foraging west of Pat Mtn
Cu Mtn	7/31/05	F	Adt	24	# 118	Must Mtn & Whet Mtn	8/21, 8/24, 8/27, '05	228 243 238	Bat foraging SE of Must (21) & SE of Whet (24) & SW of French Joe Canyon in Whet (27th).
Cu Mtn	7/31/05	F	Juv	23.5	# 241	Whet Mtn	8/29 '05	240	Bat foraging NW of Whet
Total	2004 to 2005	3 F	2 Adt 1 Juv		3 RAD	3 Mtns in SE AZ	5 days		All bats detected while foraging

Table 6: Field data notes for *L. curasoae* marking project. Cu Mtn = Cooper Mountain *L. curasoae* maternity roost; w/ = with; M = Male; F = Female; Unk = Unknown sex; Adt = Adult; Juv = Juvenile bat 2005 birth; PIT = micro-chips; RAD = Radio transmitter; SWAB= DNA cheek sample collected; hrs = hours; Mtn = Mountain; CNM = Chiricahua National Monument; n-v = night-vision goggles; IR = Infrared; @ = at; TX = Texas; sw = southwest; se = southeast; n = north; w = west; min = minutes; FBNHS = Fort Bowie National Historic Site; campgrnd = campground; FJC = French Joe Canyon;

DATE	LOCATION	TIME	ACTIVITY	NOTES
7/18/05	Cu Mtn Bat Roost	1100 to 1400 hrs	Installed micro-chip antenna w/BioMark, Inc.	Customized antenna installed @ south entrance of bat roost
7/24/05	Bluebird Mine Bat Roost	1900 to 2300 hrs	Netted, marked, and collected DNA from *L. curasoae* at roost.	Bats netted (38) - 13 M, 23 F, 2 Unk; 6 Adt, 32 Juv; 10 PIT, 2 RAD, 26 SWAB.
7/30/05	Cu Mtn Bat Roost	1900 to 2330 hrs	Netted, marked, and collected DNA from *L. curasoae* at roost.	Bats netted (19) – 13 M, 6 F; 1 Adt, 18 Juv; 6 PIT, 1 RAD, 15 SWAB.
7/31/05	Cu Mtn Bat Roost	1900 to 2300 hrs	Netted, marked, and collected DNA from *L. curasoae* at roost.	Bats netted (28) – 12 M, 16 F; 3 Adt, 25 Juv; 6 PIT, 7 RAD, 25 SWAB.
8/01/05	Cu Mtn Bat Roost	1830 to 2230 hrs	Netted, marked, and collected DNA from *L. curasoae* at roost.	Bats netted (3) – 1 M, 2 F; 1 Adt, 2 Juv; 2 PIT, 1 RAD, 3 SWAB.
8/03/05	Patagonia Mtn	1900 to 2400	Radio telemetry	Scanned for bats in Harshaw Creek area
8/04/05	Huachuca Mtn	1900 to 2400	Radio telemetry	Scanned for bats in Miller Canyon
8/07/05	Chiricahua Mtn (west side)	1930 to 2430	Radio telemetry	Scanned for bats at top of CNM lookout area
8/08/05	Whetstone	1900 to 2400	Radio telemetry	Scanned for bats in rear campgrnd @ Kartchner Caverns
8/09/05	Patagonia Mtn	1900 to 2430	Radio telemetry	Scanned for bats in Harshaw Creek area
8/10/05	Dragoon Mtn	1900 to 2300	Radio telemetry	Scanned for bats at top of road pass in Dragoons
8/11/05	Huachuca Mtn	1930 to 2130	Radio telemetry, n-v, video camera w/IR light	Scanned for bats w/radios, observed w/n-v, & video taped exit @ State of TX Mine roost
8/14/05	Chiricahua Mtn (west side)	1900 to 2300	Radio telemetry	Scanned for bats on slope @ entrance of CNM
8/15/05	Kino Springs	1830 to 2300	Radio telemetry	Scanned for bats along Santa Cruz River & golf course in Nogales
8/16/05	Dragoon Mtn	1830 to 2330	Radio telemetry	Scanned for bats on slope in Middle March Canyon
8/17/05	Rincon Mtn	1900 to 2130	Radio telemetry	Scanned for bats in Vail, Cienga Creek, and Colossal Cave areas
8/17/05	Whetstone Mtn	1930 to 2330	Radio telemetry	Scanned for bats in rear campgrnd @ Kartchner Cavern
8/18/05	Huachuca Mtn	1930 to 2000	Radio telemetry, n-v, video camera w/ IR light	Hard rainstorm @ 2000. No observations.
8/19/05	Patagonia Mtn	1830 to 2030	Radio telemetry, n-v	Scanned for bats and observed w/n-v @ Patagonia bat roost

Table 6 continued				Karen Krebbs
8/20/05	Chiricahua Mtn (east side)	1830 to 2030	Radio telemetry & n-v	Scanned for bats and observed w/n-v @ Hilltop Mine
8/20/05	Tucson Mtn	1930 to 2230	Radio telemetry	Scanned for bats @ ASDM overlook to sw
8/20/05	Huachuca Mtn	1900 to 2100	Radio telemetry, n-v, video camera w/ IR light	Scanned for bats w/radios, observed w/n-v, & video taped exit @ State of TX Mine roost
8/21/05	Mustang Mtn	1900 to 2300	Radio telemetry	Scanned for bats on ranch @ foot of Mustangs (west side). Detected #118 for 8 min se Mustangs
8/22/05	Huachuca Mtn	1930 to 2200	Radio telemetry	Scanned for bats in Miller Canyon & Buffalo Soldier area
8/2205	Canelo Hills	1930 to 2300	Radio telemetry	Scanned for bats in Canelo Hills area
8/24/05	Whetstone Mtn	1900 to 2200	Radio telemetry	Scanned for bats in rear cmpgrnd in Kartchner Caverns and detected #118 for 4 min se of Whetstones
8/24/05	Catalina Mtn	1930 to 2200	Radio telemetry	Scanned for bats in Bear Canyon/Sabino Canyon area
8/25/05	Huachuca Mtn	1900 to 2130	Radio telemetry, n-v, video camera w/IR light	Scanned for bats w/radios, observed w/n-v, & video taped exit @ State of TX Mine roost
8/25/05	Mustang Mtn	1900 to 2100	Radio telemetry	Scanned for bats n of Mustang Mtn
8/26/05	Kino Springs	1900 to 2200	Radio telemetry	Scanned for bats along Santa Cruz River & golf course in Nogales
8/26/05	Dos Cabeza Mtn	1900 to 2200	Radio telemetry	Scanned for bats on slope at FBNHS in Dos Cabeza Mtn
8/27/05	Whetstone Mtn	1900 to 2230	Radio telemetry	Scanned for bats @ foot of Whetstones (w side) & detected #118 for 3 min sw of FJC road
8/28/05	Chiricahua Mtn (east side)	1900 to 2200	Radio telemetry & n-v	Scanned for bats and observed w/n-v near Buckelew Mine
8/29/05	Whetstone Mtn	1900 to 2200	Radio telemetry	Scanned for bats in rear campgrnd in Kartchner Caverns
8/29/05	Whetstone Mtn	1900 to 2200	Radio telemetry	Scanned for bats s of Kartchner Caverns & w of Whetstones. Detected #241 flying nw towards Whetstones.
8/30/05	Whetstone Mtn	1900 to 2200	Radio telemetry	Scanned for bats @ foot of Whetstones (w side) & on French Joe Canyon Road
8/31/05	Huachuca Mtn	1900 to 2100	Radio telemetry, n-v, video camera w/IR light	Scanned for bats w/radios, observed w/n-v, & video taped exit @ State of TX Mine roost
29 Nights Total	**6 bat roosts; 10 Mountain Ranges; 3 additional locations;**	**118 Hrs of Radio Telemetry**	**Techniques utilized - Radio telemetry, n-v, video camera w/ IR lights**	**2 bats (#118 & #241) detected 4 evenings. #118 detected 3 different times in 2 different Mtn (Mustang & Whetstone). #241 detected once near Whetstones.**

Table 7: Radio telemetry data from the Bluebird Mine and Copper Mountain Mine for July 24, 30, 31, 2005 and August 1, 2005. Eleven *Leptonycteris curasoae* were marked with radio transmitters and monitored during the four marking field days. TRANS. FREQ. = Radio Transmitter Frequency; MARK = Marking; BB = Bluebird Mine; CU = Copper Mountain Mine; 2nd = Second; @ = At; OPCNM = Organ Pipe Cactus National Monument; Aug. = August;

TRANS. FREQ.	MARK DATE	ROOST MARKED	NOTES
150.080	08/01/05	CU	
150.100	07/31/05	CU	Bat detected for 2nd night @ OPCNM on 8/01
150.118	07/31/05	CU	Bat detected for 2nd night @ OPCNM on 8/01
150.142	07/31/05	CU	
150.171	07/31/05	CU	Bat detected for 2nd night @ OPCNM on 8/01
150.191	07/31/05	CU	
150.210	07/31/05	CU	
150.241	07/31/05	CU	
150.286	07/24/05	BB	
150.312	07/24/05	BB	
150.758	07/30/05	CU	

150.118 later detected in Mustang and Whetstone Mountains during August telemetry searches.
150.241 later detected in Whetstone Mountains during August telemetry searches.

Table 8: Summary for *Leptonycteris curasoae* radio telemetry tracking results at the Bluebird Mine, Copper Mountain Mine, and southeastern Arizona (Frequency # 118 and # 241), July-August 2005. BB = Bluebird Mine; CU = Copper Mountain Mine; SE = Southeast; NE = Northeast; E = East; NW = Northwest; min. = minutes; Mtn = Mountains;

Frequency 286 – Adult female, post-lactating		
Date	**Times Detected**	**General Location/Movement**
07/24/05	Transmitter attached	Bat flew away from the BB roost and to the SE

Frequency 312 – Adult female, post-lactating		
Date	**Times Detected**	**General Location/Movement**
07/24/05	Transmitter attached	Bat flew away from the BB roost and to the SE

Frequency 758 – 2005 birth male		
Date	**Times Detected**	**General Location/Movement**
07/30/05	Transmitter attached @ 22:28	Bat flew back into CU roost (south) after being marked.
07/30/05	22:58	Bat leaves roost and flies SE towards a canyon

Frequency 241 – 2005 birth female		
Date	**Times Detected**	**General Location/Movement**
7/31/05	Transmitter attached	Bat flew back into CU roost (south) after being marked
08/29/05	20:32 – 20:36	Bat moving NW of Whetstone Mtn

Frequency 210 – 2005 birth female		
Date	**Times Detected**	**General Location/Movement**
07/31/05	Transmitter attached	Bat flew back into CU roost (south) after being marked

Frequency 191 – Adult female, post lactating		
Date	**Times Detected**	**General Location/Movement**
07/31/05	Transmitter attached	Bat flew SE towards a canyon

Frequency 171 – 2005 birth male		
Date	**Times Detected**	**General Location/Movement**
07/31/05	Transmitter attached@ 20:14	Bat flew NE after being marked
08/01/05	21:26	Bat appeared to exit from CU (south) and flew E towards a mountain.

Frequency 142 – 2005 birth male		
Date	**Times Detected**	**General Location/Movement**
07/31/05	Transmitter attached @ 20:58	Bat flew SE after being marked
07/31/05	21:22	Bat detected E of roost

Frequency 118 – Adult female, post lactating		
Date	**Times Detected**	**General Location/Movement**
07/31/05	Transmitter attached @ 21:06	Bat flew back to CU roost (south) for 9 min.
07/31/05	21:15	Bat flew out of CU roost (south) and flew NE
07/31/05	21:22	Bat detected E of roost.
08/01/05	20:54	Bat detected E towards a mountain.
08/21/05	20:18 – 20:25	Bat moving SE of Mustang Mtn
08/24/05	20:21 – 2005	Bat moving SE of Whetstone Mtn
08/27/05	1945 - 1949	Bat moving SW of French Joe Canyon (Whetstone Mtn)

Frequency 100 – 2005 birth female		K. Krebbs
Date	**Times Detected**	**General Location/Movement**
07/31/05	Transmitter attached @ 21:28	Bat flew SE towards a canyon after being marked
07/31/05	21:42	Bat was detected as it flew into CU roost (south)
08/01/05	20:17	Bat was detected moving NE

Frequency .080 – adult female, post lactating		
Date	**Times Detected**	**General Location/Movement**
08/01/05	Transmitter attached @ 20:57	Bat flew SE towards a canyon after being marked

Table 9: Summary for *Leptonycteris curasoae* 2-year marking project at Copper Mountain (Organ Pipe Cactus National Monument) and Bluebird Mine (Cabeza Prieta NWR) in southern Arizona. # BATS HAND = Number of Bats Handled; # BATS MARK = Number of Bats Marked; ADT/JUV/UNK = Adult/Juvenile/ Unknown; PIT TAG = Micro-Chip; RAD = Radio Transmitter; SWAB = DNA Cheek Sample Collected;

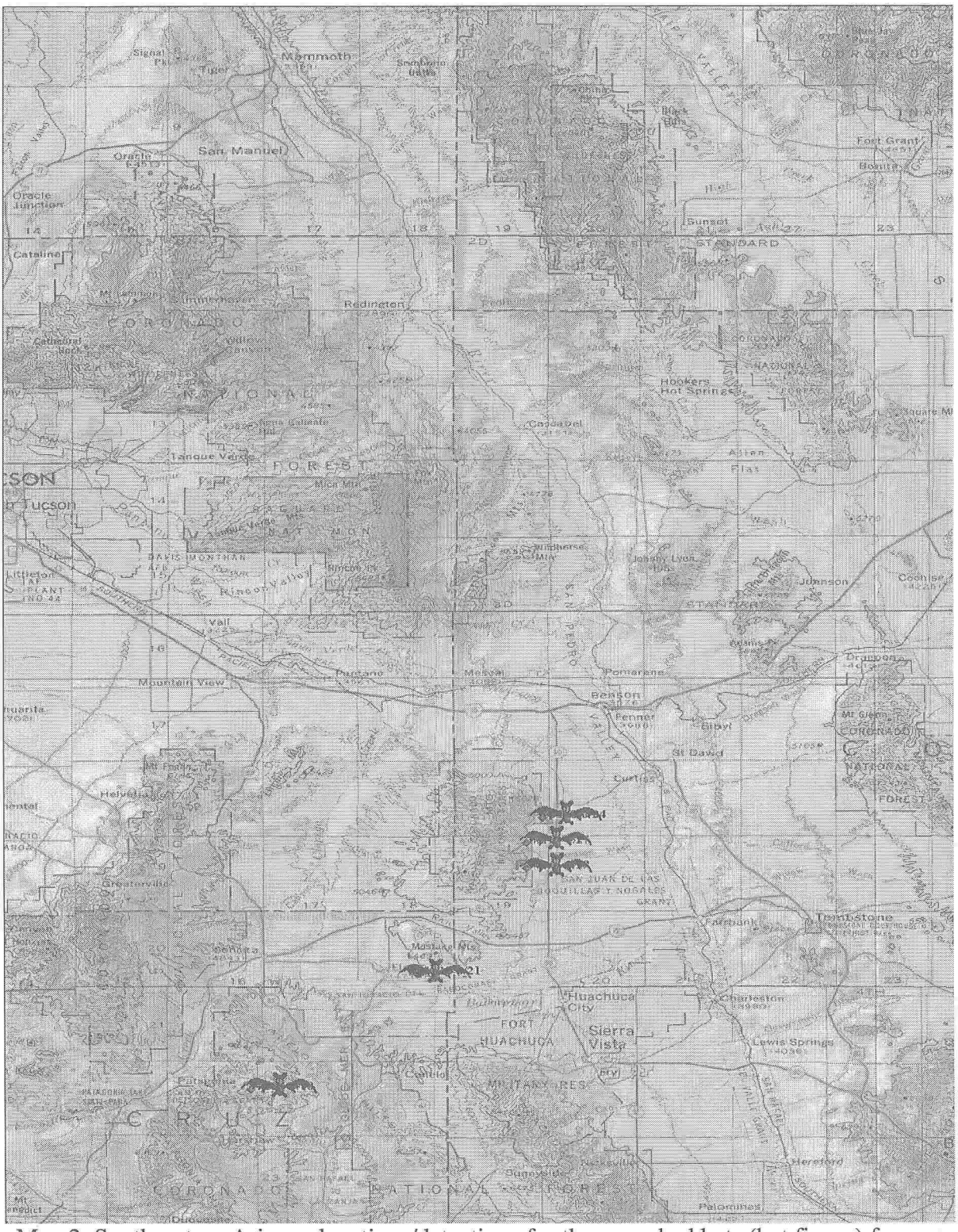
YEAR	# BATS HAND	# BATS MARK	ADT/JUV/ UNK	PIT TAG	RAD	SWAB	NOTES
2004	118	71	21/96/1	60	11	72	1 bat detected in Patagonia Mtn
2005	88	35	11/77	24	11	69	2 bats detected near Mustang & Whetstone Mtn
TOTALS (2004 - 2005)	**206**	**106**	**32/173/1**	**84**	**22**	**141**	**3 bats (2 ADT, 1 JUV) detected in southeast AZ.**

Table 10: Data for micro-chip antenna and reader at the Copper Mountain roost for five *L. curasoae* during August, 2005. BAT # = PIT TAG Number for each bat; M = Male; F = Female; Juv = Juvenile 2005 birth; MARK = Date bat originally marked; DETECT DATE = Date bat detected with antenna; # TIMES, DATE, ACT TIME, DETECT = Number of times, date, and actual time (hour:minute) bat is detected flying through the antenna; min = minutes; b/t = between;

BAT #	SEX	AGE	MARK	DETECT DATE	# TIMES, DATE, ACT TIME, DETECT	NOTES
# 23	F	Juv	07/30/05	08/02/05	2X on 08/02 (21:32; 22:24)	52 min b/t detections
# 54	M	Juv	07/31/05	08/02/05	1X on 08/02 (22:14)	Only detected 1X.
# 79	F	Juv	07/31/05	08/02/05 08/05/05	3X on 08/02 (23:03, 23:05, 23:06); 5X on 08/05 (21:47, 21:54, 21:56, 22:02, 22:03)	08/02 - 2 min and 1 min b/t detections; 08/05 – 7, 2, 6, 1 min b/t detections;
#106	M	Juv	07/30/05	08/02/05	1X on 08/02 (23:02)	Only detected 1X.
# 119	M	Juv	07/31/05	08/02/05 08/03/05 08/04/05 08/05/05	1X on 08/02 (23:06) 1X on 08/03 (22:17) 1X on 08/04 (21:42) 1X on 08/05 (21:31)	Only detected 1X each evening.
TOTAL 5 BATS DETECT	**3 M 2 F**	**5 Juv**			**16 Detections over 4 days**	



Map 1: Southern Arizona. Organ Pipe Cactus National Monument (Copper Mountain Mine) and Cabeza Prieta National Wildlife Refuge (Bluebird Mine) where bats were marked. Southeastern Arizona Mountains (Patagonia, Mustang, Whetstone) where marked bats were located (right side) for the 2004-2005 marking study. **Krebbs**



Map 2: Southeastern Arizona locations/detections for three marked bats (bat figure) for 2004-2005. Radio frequency # 329 located in Patagonia Mountains on 8/10/04, # 118 located near Mustang Mountains on 8/21/05 and Whetstone Mountains on 8/24/05, 8/27/05, and # 241 located near Whetstone Mountains on 8/29/05. **# 118 was located in two mountain ranges (Mustang and Whetstone) in 2005.** **Krebbs**

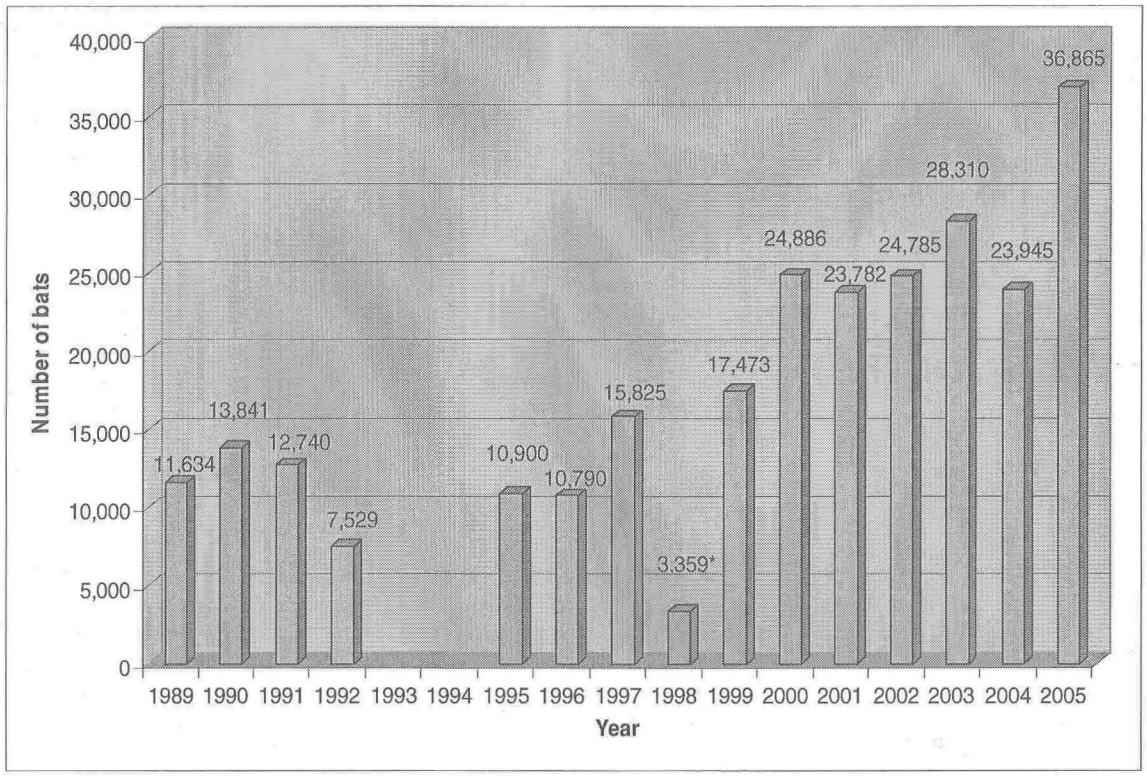


Figure 13. Average of June exit flight estimates of *Leptonycteris curasoae* at Copper Mountain, Organ Pipe Cactus National Monument, Arizona. Data for 1989-1992 are from Dalton and Dalton (1994). Data for 1995-2005 are from Organ Pipe Cactus National Monument annual endangered species reports. No June estimates were made in 1993-1994. (*In June 1998, bats appeared to be disturbed during the low single estimate made. This aberrant exit flight was bracketed by more typical estimates of 19,700 on May 26, and 15,850 on July 28.)

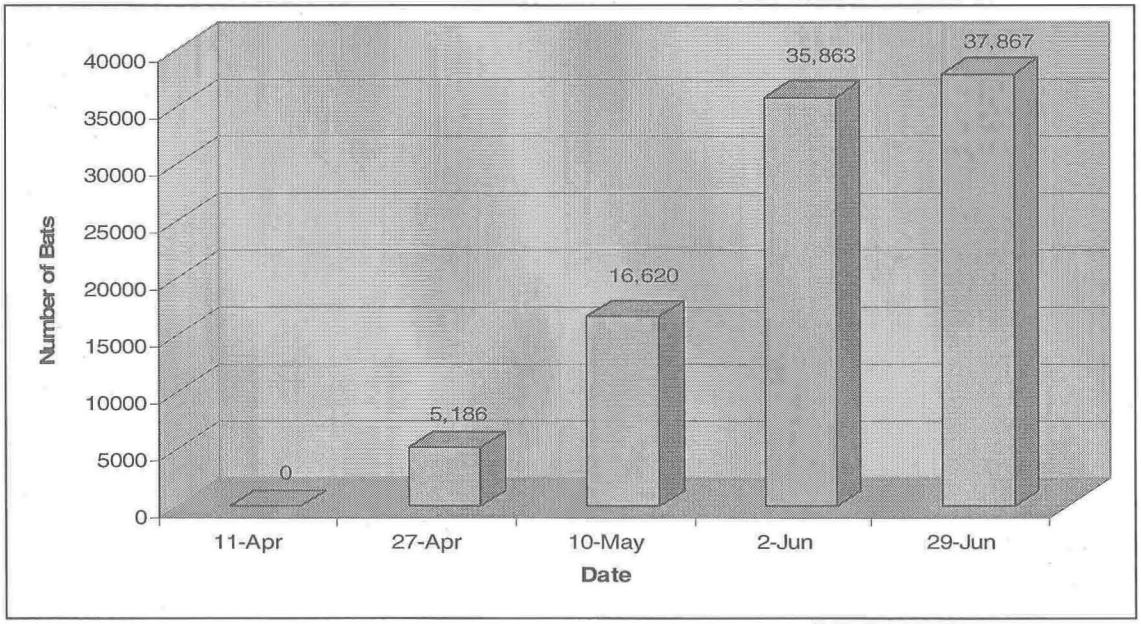


Figure 14. Year 2005 exit flight estimates for of *Leptonycteris curasoae yerbabuenae* at Copper Mountain, Organ Pipe Cactus National Monument, Arizona. All estimates were made live except 29 June, which was estimated from night-vision digital videotape at 1/5 speed. Krebbs

APPENDIX

Meeting Notes, Letters, Progress Reports, Captive Project Notes, Schedule, and Pit Tagging Protocol for 2004-2005 Project

Meeting with USDA 18/Feb/2004

Agenda: Establishing IACUC and Research Facility registration

Present Warren Striplin USDA inspector, Shawnee Riplog-Peterson, Karen Krebbs, Craig Ivanyi via phone

Karen outlined her study that will be performed on –grounds. She explained how the information gathered using the California leaf-nosed bat will translate to her fieldwork with the endangered lesser long-nosed bat. Karen explained that all permits were in place, housing for the bats was defined, and that AZA, AZGF, US FWS, and the (AZA Bat TAG) were very much in support of the project. She also explained that AZA awarded funds in support of the project. Mr. Striplin was very complementary of the support we were getting from all of these organizations and stated we should reflect this in our application for registration.

Mr. Striplin stated that he ran the proposed project by an Animal Care Specialist in Fort Collins, and she did indeed deem that this falls under Research Facility Registration guides.

To obtain a research facility registration we must first

- Establish an IACUC see pg. 25 subpart C
- Apply for research facility registration
- Follow all guidelines as outlined in Animal Welfare Act and Animal Welfare Regulations

Mr. Striplin asked who the PI was for this project and Karen stated that she would be the PI. He explained that the PI is responsible for the care, use, housing protocols. Also, we must document all care and behavior of bats while in captivity. The PI must justify the # of animals used, and perform a literature search to confirm that this research has not been done prior or demonstrate that repeating this research is necessary and valuable.

He stated we should:

- Get in touch with Susan Wilson-Saunders at the University of Arizona she may be a big help to us.
- Take copious notes must be taken at IACUC meeting. This is something that the VMO (Veterinary Medical Officer) pays close attention to.
- Have at least one of the committee members be a lab animal veterinarian.
- Establish the IACUC before we register. He could not emphasize enough how important this is.
- Definitely use certified mail when we send back the registration materials. If we have any questions or concerns, please e-mail him and he will help.

He explained that there is no fee for the registration, only paperwork. If we are not doing any research for a period of time, we can notify Fort Collins and be placed on an inactive list.

He asked what he could do to expedite this process; he would help in any way. He will call Fort Collins and get the registration application, and get it to us. He stated that he is working with a VMO later this month and asked Karen to send him examples of the tagging she will be using so he may show it to a VMO. This may help to expedite the process and reduce the number of questions that the VMO will have later on.

Macrotus californicus Captive Marking Project at ASDM

Karen Krebbs
13 May 2004

I. Field

a. Scouted roost in Tucson Mountains on April 4, 2004. The evening was wet, humid, and cold. The bats flew despite the weather conditions.

b. Collected 10 ♂ *Macrotus californicus* outside the roost on April 7, 2004. Netted 22 bats (10 ♀s and 12 ♂s). Chose 10 ♂s for the captive project. Bats were weighed, examined, and transported to ASDM. Bats were hand-fed and placed in their holding cage at ASDM.

c. Gated mine adit GPS coordinates are [redacted] This adit sits between 2 others but is the only one gated.

II. Captivity

a. Bats hand-fed for 2 evenings (April 7-8). By April 9th all bats were feeding out of plastic food dishes and doing well in captivity. Bat weights on April 7th : #1 = 12 g; #2 = 13 g; #3 = 12 g; #4 = 12 g; #5 = 11 g; #6 = 13 g; #7 = 13 g; #8 = 12 g; #9 = 12 g; #10 = 12 g; No Markers.

b. Bat weights on April 11th: #1 = 11.99 g; #2 = 14.19 g; #3 = 12.67 g; #4 = 10.98 g; #5 = 10.81 g; #6 = 13.25 g; #7 = 12.90 g; #8 = 11.98 g; #9 = 12.75 g; #10 = 12.48 g; No Markers.

c. Necklaces: On April 13th, #1 and #4 were fitted with necklaces. #1 = 8+7+2+1 (.61 g, Red); #4 = 8+7+2+1 (.61 g, Gray); Necklace = .50 g and band/tape = .11 g; Space b/t neck and necklace = 8.0-9.0 mm.
On April 14th, #4 had necklace in mouth and cut off; On April 14th, put necklaces on #2 (Yellow), #3 (Red), #5 (Gray), #6 (Yellow), #7 (Gray), #8 (Gray), # 9 (Red), #10 (Red). On April 15th, #5 and #10 had necklaces in mouth and cut off; #7 had chewed through his necklace (8+8) and found on the floor;
Put another necklace on #7(8+6+2+1) Red. All other necklaces are 8+7+2.

#1 – N=Red; No band.	FA = 49.3 mm
#2 – N=Yellow; Band=Red;	FA = 52.3 mm
#3 – N=Red; Band=Yellow;	FA = 50.8 mm
#4 – No necklace or band;	FA = 49.3 mm
#5 – No necklace or band;	FA = 48.7 mm
#6 – N=Yellow; No band;	FA = 51.8 mm
#7 – N=Red; No band;	FA = 51.0 mm
#8 – N=Gray; Band=Yellow;	FA = 49.9 mm
#9 – N=Red; Band=Silver;	FA = 49.3 mm
#10 – No necklace; Band=Red;	FA = 49.8 mm

d. Wristbands: On April 14th, banded #9 (Red) and #10 (Red) with wristbands (.11g). On April 15th, banded #2 (Red), #3 (Yellow), and #8 (Yellow) with wristbands (.11g). Lamborn Lipped Bands. On April 19th, wristbands were removed from #2, #8, and #10 because of rubbing and wing damage. On April 23, #3 and #9 had their wristbands removed because of irritation.

e. Microchips: On April 19th, microchips (yellow tape) were placed on the backs of #4, #5, and #10. The weights of the microchips ranged from .07 to .10 g. By April 20th, #4 and #10 had removed their microchips. #5 retained his microchip for 14 days (to May 2nd).

f. Fluorescent Powder: Placed fluorescent powder on back (dorsum) and belly (venter) of #4 and #10 on April 23rd. Powder still visible 7 days after application but bats scratching and rubbing areas with powder. Powder detected in guano 1 day after application but no day thereafter.

g. Bats Flown with Markers in Captivity: On April 25th, we flew the 10 bats in the holding room to test the visibility of markers. We filmed the bats and markers with video cameras and observed the markers with night-vision and bright light. The microchip was very visible when the bat was in a position (hanging on wall) and could also be detected during flight. Necklaces were harder to detect when bats were hanging but showed up at times during the flight. Markers could be detected with both night-vision, video cameras, and bright light. The bats eyes were also visible with the night-vision, video cameras, and bright light.

III. Bat Roost in Tucson Mountains (N 32° 10' 03.1" W 111° 01' 22.5" 2687 ft.)

a. Bats Released at Roost with Markers: On April 27th, 4 bats (#3, #4, #7, and #9) were returned to their roost in the Tucson Mountains at 1900 hours and released. Three of the bats had necklaces and one bat had fluorescent powder. The bats' exit from the roost will be monitored for marker visibility in the future. On May 6, 2004, one more bat (#6) with a necklace was released at the roost.

b. Visibility of Markers at Roost: On April 27th, we were able to recognize one of the marked bats within the roost that had been released earlier. We could see the necklace and reflective markers. We watched the bat exit but were not positive that we could see any of the bats flying with the markers. On May 6th more observations were carried out at

roost after a bat was released. None of the marked bats were observed outside the roost but two of the marked bats were seen hanging on the wall inside the roost with night-vision goggles.

IV. Captive Bats at ASDM

a. Conversations with Arizona Game and Fish Department (AZGFD) Bat Project Coordinator Angie McIntire took place on April 21st about the release of marked bats. Angie gave me permission to release 5 bats at the roost where the bats were collected. She felt it was important to determine if the marked bats could be recognized in the wild. Angie also agreed to allow ASDM to keep some of the bats for an upcoming exhibit. Angie said that if I were comfortable with the new exhibit for the bats then she would support ASDM's efforts to keep the remaining bats in captivity.

b. ASDM is working on an exhibit replication for the captive bats to test how well the bats will adjust to the new exhibit. Certain light conditions will be set-up to determine how the captive bats will react to outside factors that will resemble the new exhibit. The five remaining bats are being held under my 8-week permit from AZGFD. My permit from AZGFD for the captive project is valid until June 1, 2004, at which time the bats must either be released or transferred to the Mammalogy and Ornithology Department collecting permit. The bats will be turned over to ASDM on June 1, 2004 if the bats have adjusted to the exhibit replication and are continuing to thrive in captivity.

c. On June 1, 2004 the remaining 5 *M. californicus* in captivity were turned over to the Mammalogy and Ornithology (M&O) Department at ASDM for a future exhibit. The care of the bats will now be the responsibility of the M&O Department. Necklaces remain on 3 of the captive bats and the bats and necklaces will be monitored for problems. The necklaces will be removed from the necks of the bats before the bats are placed in the new exhibit in 2005 or sooner if problems arise.

"Understanding the Fall Migration of the Endangered Lesser Long-Nosed Bat (*Leptonycteris curasoae)* An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinators Project" Progress Report for the Period April 15, 2004 to July 1, 2004 for the Arizona Game and Fish Department Bat Management Project

Karen Krebbs
Conservation Biologist
Arizona-Sonora Desert Museum
13 July 2004

A collecting trip was made on April 7, 2004 to obtain *Macrotus californicus* for the captive portion of the bat-marking project for *L. curasoae*. Ronnie Sidner and Karen Krebbs collected ten bats at a roost in the Tucson Mountains that was suggested by Tim Snow, Arizona Game and Fish Department (AZGFD). The ten bats were held in captivity at the Desert Museum and different marking techniques performed on the bats. Marking techniques used on the captive bats included necklaces with reflective tape, micro-chips (with reflective tape) glued to the backs, wristbands, and fluorescent powder. The observations and results of the captive bat marking study indicated that wristbands, necklaces, and fluorescent powder were techniques that produced some negative results on a bat species in the *Phyllostomidae* family (i.e. *M. californicus).* Additional information from Rodrigo Medellin in Mexico indicated that the *L. curasoae* that had necklaces placed on them in 2003 in southern Mexico were recaptured with injuries from the necklaces. It was decided that the use of radio transmitters and micro-chips for this project would not harm the bats and result in the most productive data. Also our U.S. Fish and Wildlife Service (USFWS) permit allows for marking with only micro-chips and radio transmitters. On April 27, 2004, four of the captive *M. californicus* were returned to the roost and released and on May 6, 2004 an additional bat was released. Five bats remain in captivity at the Desert Museum for an upcoming exhibit.

The USWFS have issued a permit to the Desert Museum for 2004 to mark 72 *L. curasoae* at Organ Pipe Cactus National Monument during the last part of July 2004. Additional permits have been obtained from AZGFD, the National Park Service (NPS), the U.S. Department of Agriculture Forest Service, Pima County Parks and Recreation, and Mexico to carry out the bat-marking project in Arizona and Mexico. We will place radio transmitters on 12 bats and micro-chips (with reflective tape) on an additional 60 bats at the maternity roost at Organ Pipe Cactus National Monument. We will look for the marked bats at two roosts in southwestern Arizona (Copper Mountain and Bluebird Mine) and one roost in Mexico (Pinacate) during the later part of July and the first two weeks of August. Additionally, we will look for marked bats in southeastern Arizona at several roosts (State of Texas Mine, Fort Huachuca, and the Patagonia Cave) during the month of August 2004.

In May 2004, Ronnie Sidner had to terminate her involvement with the bat-marking project because of time constraints. Ronnie's efforts towards the initial start-up for this project were beneficial and essential for a successful beginning. A University of Arizona college student (Antje Adams) has been hired to assist with the project at Organ

Pipe Cactus National Monument and another person (Robert Graf) hired to help with roost exit observations in southeastern Arizona. National Park Service staff Tim Tibbitts, Ami Pate, and Barbara Alberti will participate in the marking project at Organ Pipe Cactus National Monument and Coronado National Memorial. U.S. Fish and Wildlife Service biologist Curt McCasland will help with the roost exit observations at the Bluebird Mine in Cabeza Prieta and Eugenio Larios (Pinacate biologist) will assist with the Pinacate roost observation in northern Mexico.

Expenses incurred during the period April 15 to July 1, 2004 include costs for collecting *M. californicus,* nets, captive bat care, PI's time, marking items, field gear, radio transmitters, antenna system, and micro-chip reader.

The field season for the bat-marking project for *L. curasoae* at Organ Pipe Cactus National Monument will begin on July 19, 2004. Up to four weeks will be spent at Organ Pipe Cactus National Monument during July and August marking and following the bats. After this period more time will be spent in southeastern Arizona during August looking for marked bats. The battery life for the radio transmitters is 21 days and the life of the Skinbond (surgical glue) for the transmitters and micro-chips is three to four weeks, at which time the transmitters and micro-chips will fall off the backs of the bats.

"Understanding the Fall Migration of the Endangered Lesser Long-nosed Bat (*Leptonycteris curasoae)* An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinators Project" Progress Report for the Period July 1, 2004 through September 30, 2004 for the Arizona Game and Fish Department Bat Management Project and the National Park Service

Karen Krebbs
Conservation Biologist
Arizona-Sonora Desert Museum
10 September 2004

The field season for the *Leptonycteris curasoae* bat-marking project began on July 19, 2004 at Organ Pipe Cactus National Monument (ORPI). Three weeks were spent at ORPI marking and tracking the bats. National Park Service Biologists Tim Tibbitts and Ami Pate participated in the project at ORPI and a University of Arizona undergraduate Antje Adams was hired to assist with the project. Permits from the Arizona Game & Fish Department (AZGFD), U.S. Fish & Wildlife Service (USFWS), National Park Service (NPS), and U.S.D.A. Forest Service (USDAFS) were obtained to carry out the *L. curasoae* marking project. The Pinacate Bat Cave roost visit was made under a collaborative agreement that the Arizona-Sonora Desert Museum has with Mexico. Curt McCasland (USFWS Biologist) helped with the roost checks at the Bluebird Mine in Cabeza Prieta Wildlife Refuge and Keno Larios (Pinacate Biologist) participated in the project at ORPI and the Pinacate Bat Cave roost in Mexico.

A total of 118 *L. curasoae* were caught in nets at the Copper Mountain roost at ORPI. Seventy-one bats were marked at the Copper Mountain roost on July 19, 20, and 21, 2004. Sixty bats were marked with micro-chips with reflective tape and 11 bats were marked with radio transmitters. All markers were glued to the backs of the bats. Radio transmitters (11) were used exclusively on adult female *L. curasoae.* The weights for the 11 females ranged from 21 grams to 26 grams (average weight was 23.1 grams). The radio transmitter weighed 0.52 grams. The weight of the radio transmitter to adult female bat body mass ratio ranged from 3.0 to 3.8 %. Forty-nine micro-chips were placed on juveniles (male and female) and 11 on adult females. The micro-chip with reflective tape weighed 0.11 grams or less. The weights for the 49 juveniles ranged from 19 grams to 27 grams (average weight was 22.0 grams). The weight of the micro-chip with reflective tape to juvenile bat body mass ratio ranged from .41 to .57 %. The weights for the 11 adult females ranged from 22 grams to 29 grams (average weight was 24.2 grams). The weight of the micro-chip with reflective tape to adult female bat body mass ratio ranged from 0.38 to 0.50 %. All markers placed on the backs of adult females and juveniles were well under the recommended 5 % of the body mass of the bat.

During the netting at ORPI, all bats were immediately removed from the nets, placed in a cloth bag, and processed. Each bat was weighed, age determined, and sexual condition accessed. Cheek swabs (for DNA analysis) were taken from the mouths of 72 bats. All 72 samples have been turned over to Dr. Melanie Culver (University of Arizona) for DNA analysis. All bats were processed and released in less than 20

minutes. If we determined that the bats were too young for marking with micro-chips, we weighed and sexed the young bats, and released them. All bat handlers were experienced Bat Biologists (Karen Krebbs, Tim Tibbitts, Ami Pate). During marking and processing, no mortality occurred, and bats flew away when released. We made the decision to mark individuals based on age, weight, and general physical condition of the bat. We did not want to mark young bats that may have just started to fly (or leave the roost) or adult females that were still lactating.

Once the bats were marked, we monitored roosts at Copper Mountain, Bluebird Mine, and the Pinacate Bat Cave roosts from July 22 to August 3, 2004. Each evening video cameras with IR lights, a micro-chip reader and antenna, night-vision goggles, and radio telemetry equipment were utilized outside the roosts to locate marked bats. Bats marked with the micro-chips and reflective tape were detected with the night-vision goggles outside the Copper Mountain roost. Even though many bats flew within the required distance of detection (15 inches) for the micro-chip reader/antenna, we did not detect any of the bats marked with micro-chips with the antenna. We are still examining videotapes for marked bats and this method for detection is inclusive at this time. Radio telemetry equipment was also used at other locations within ORPI to locate marked bats that were foraging. Many of the bats with radio transmitters were detected from July 22 to August 2, 2004 at ORPI. After this time we were unable to locate the bats that were marked with the transmitters within ORPI. We concluded that these females had probably moved on to other areas or the radio transmitter had fallen off the backs of the bats. We began looking for the marked bats in other locations in southeastern Arizona.

Fifteen trips were made in August to the Chiricahua, Huachuca, and Patagonia Mountains of southeastern Arizona to search for marked bats. Robert Graf was hired to help with roost monitoring and the location of marked bats in southeastern Arizona. The Patagonia Bat Cave, Fort Huachuca Bat Caves, and the State of Texas Mine roosts were checked for marked bats. The micro-chip reader/antenna and the radio telemetry equipment were setup outside these roosts to search for marked bats. Radio telemetry equipment was also utilized on hilltops in the Chiricahua, Huachuca, and Patagonia Mountains to search for the marked bats. On August 10, a bat that had been marked with a radio transmitter (at ORPI) was detected in the Patagonia Mountains. This bat was detected twice (within a 5 minute period) with the radio telemetry equipment as it foraged in the valley of the Patagonia Mountains. This was the only bat detected in southeastern Arizona with the radio telemetry equipment. We did not detect other marked bats with either the night-vision goggles or the micro-chip reader/antenna in southeastern Arizona. We are still examining the videotapes for southeastern Arizona.

The micro-chip reader/antenna was placed outside the roost at Copper Mountain (both north and south entrances), Bluebird Mine, Pinacate Bat Cave, Patagonia Bat Cave, and the State of Texas Mine. Bats at all the above roosts with the exception of the State of Texas Mine, did not hesitate to fly close to or around the micro-chip reader/antenna that was setup outside the roost. At the State of Texas Mine, the bats appeared to change their normal exit flight to avoid coming near the micro-chip reader/antenna and during one evening the bats refused to exit the roost while the reader/antenna was in place. The

State of Texas Mine roost is the only roost (mentioned above) that is gated or has a chain barrier at the entrance. The radio telemetry equipment was also setup outside the State of Texas Mine roost but at a greater distance from the roost entrance than the micro-chip reader/antenna. The bats seemed to ignore the radio telemetry equipment and often flew close to the equipment. During one evening, one of the bats flying out of the roost even tried to hang on the radio telemetry equipment. The gate and metal mesh at the entrances of the State of Texas Mine may compromise the bats exiting the roost and the micro-chip reader/antenna may have compounded the bat's anxiety. The other equipment that was set further away from the roost entrance did not solicit the same negative response from the bats as the micro-chip equipment at the State of Texas Mine

The location of one bat on August 10, 2004 in the Patagonia Mountains is the first evidence that we have that some of the bats are moving from the southwest to the southeast part of the state. The first year of the *L. curasoae* marking project has illustrated the complexity of marking this endangered species. More research should be conducted as a continuation of this project. The short lifespan of the surgical glue that held the micro-chips on the bats in 2004 and the area constraints of the micro-chip antenna make our chances of locating marked bats low. In 2005, the goal for this project is to obtain all necessary permits to implant micro-chips to *L. curasoae.* Implanted chips would allow us to search for bats longer into the season and again in following seasons without recapturing the bats. We are also working with Biomark, Inc. to improve the range of distance for detection with the micro-chip antenna for future work.

Expenses incurred during the period July 1 to September 30, 2004 include costs for equipment, field gear, PI's time, project contractor's time, travel, housing, etc. A final report for the *L. curasoae* marking project will be created by the end of 2004.

April 12, 2005

Tim Tibbitts
Organ Pipe Cactus National Monument
10 Organ Pipe Drive
Ajo, AZ 85321-9626

(520) 387-6849 x 7114
Re: PIT Monitoring System for Copper Mountain Maternity Roost

Dear Tim,

This letter is to provide information concerning the requirements for the installation of a PIT monitoring antenna system at the south entrance of the Copper Mountain roost. The purpose of the proposed antenna is to monitor movement of tagged lesser long-nosed bats (Leptonycteris curasoae) in and out of the south entrance starting in July 2005.

Based on information provided about the location, Biomark will construct a 2 X 3' pass-through antenna to be installed using an existing wood frame at the south entrance. The antenna will be configured to the TX1400ST tag (134.2kHz, 12mm). Bat flight speed through the antenna is estimated at 20ft/sec. There is no available power at the site and 12V batteries will need to be supplied by the customer. The FS2001F-ISO reader will also be supplied by the customer. The reader has an internal memory of 4,000 tag codes with a date/time stamp, data will be manually downloaded on a daily basis. The antenna set-up will include the reader, antenna and tuning box. The enclosure will be provided by the customer and will house the reader, tuning box and battery.

This application is unique and has not been previously tested or proven, Biomark will provide support for the system with this understanding. There are some concerns that have the potential to create interference with detection. It is currently unknown whether echolocation will cause antenna vibration which may affect the performance of the antenna. Also, if tagged bats are gathered at the cave entrance there may be interference with the antenna.

Even with the small number of PIT tagged bats at the roost there is the potential to collect valuable data about movement. It is recommended that an additional antenna be placed at the north entrance in order to obtain increased efficiency. Due to funding limitations, one of the two entrances will be monitored at this time. Biomark will work in

conjunction with Karen Krebbs of the Arizona-Sonora Desert Museum on this project

and will contribute a portion of the installation cost. Studies involving capture-recapture,
movement, abundance, survival and recruitment have confirmed that PIT technology is a
reliable and promising method of identifying and monitoring small mammals. Biomark
has a genuine interest in the variety of ways in which PIT technology is currently being
used and we are excited to see how it will be used in the future. Please feel free to
contact us with any questions.

Sincerely,
Audrey Callagher
Biomark Inc.

CC: Karen Krebbs, Arizona-Sonora Desert Museum
Sean Casey, Biomark Inc.

Budget Break Down, Copper Mountain Monitoring Antenna - South Entrance

04/11/2005

Task description Cost Per Unit Units Total
Phase 1
Antenna Development & Characterization (3 days/1 Individual)

Labor
Assemble Antenna Structure $75 4.8 $360
Wrap Antenna Coils $75 4.8 $360
Testing Labor $75 4.8 $360
System Integration $75
4.8
$360
Performance Characterization $75
4.8
$360
Material
Antenna Frame Material $26 1
$26
Wire $29 1
$29
Capacitors $60 1
$60
Antenna Protective Coating $100 1
$100
Tuning Box $325 1
$325
DC Power Cable $95 1
$95

Antenna Installation/Testing (3 days/2 Individuals)

Labor $75
48
$3,600
Per Diem $91 6 $546
Vehicle Rental $50 3 $150
Airfare $400 2 $800

Total: $7,530

17 June 2005

Scott Richardson
Wildlife Biologist
U.S. Fish & Wildlife Service
201 N Bonita, Suite 141
Tucson, AZ 85745

Dear Scott:

As part of the two-year *Leptonycteris curasoae* marking project "Understanding the Fall Migration of the Endangered Lesser Long-Nosed Bat (*Leptonycteris curasoae)* An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinator Project", we were given permission by the U.S. Fish and Wildlife Service and the United States Department of Agriculture to implant micro-chips to captive bats at the Arizona-Sonora Desert Museum (ASDM). The micro-chip implanting of the captive bats would serve as a practice session for the upcoming field season in July 2005 at Organ Pipe Cactus National Monument with the *L. curasoae* and also help ASDM with future identification of the captive bats. Our U.S. Fish and Wildlife Service permit (# TE022190-3) allows us to implant micro-chips to 20 *L. curasoae* and mark an additional 150 bats with either radio transmitters or micro-chips (with reflective tape) glued on the backs of the bats. We will also collect mouth DNA samples from all *L. curasoae* (up to 220 bats) handled in the field.

On June 17, 2005, Dr. David Edsall and Karen Krebbs implanted five captive *Macrotus californicus* and several *Antrozous pallidus* and *Eptesicus fuscus* with sterile 12 mm tags (134.2 kHz). We followed the pit tagging protocol that Bat Biologists have used at Fort Collins, Colorado for a field project on *E. fuscus.* The procedure went well and all the captive bats at ASDM can now be identified with the micro-chips. The micro-chipping technique is a common procedure that is used by veterinarians on domestic and zoological animals. This technique is being used more often by Bat Biologists in the field on wild bats. We would like to proceed with the micro-chipping technique on the wild *L. curasoae* in July at Organ Pipe Cactus National Monument.

Sincerely,

Dr. David Edsall Karen Krebbs

Tentative Field Schedule for Understanding the Fall Migration of the Endangered Lesser Long-Nosed Bat (*Leptonycteris curasoae)* An Extension of the Arizona-Sonora Desert Museum's Migratory Pollinator Project

Karen Krebbs
Conservation Biologist
Arizona-Sonora Desert Museum
14 July 2005

July 18 to July 30 – Organ Pipe Cactus National Monument marking Leptos. On July 24th we will check the Bluebird Mine at Cabeza Prieta with Curtis McCasland.

August 1 (Mon.) – Whetstone Mtns..

August 2 (Tues.) – Patagonia Mtns.

August 3 (Weds.) – Huachuca Mtns. (State of TX Mine ??).

August 7 (Sun.) – Chiricahua Mountains.

August 9 (Tues.) – Huachuca Mtns. (Miller Canyon).

August 10 (Weds.) – Patagonia Mtns..

August 14 (Sun.) – Chiricahua Mnts..

August 16 (Tues.) – Huachuca Mtns. (State of TX Mine ??).

August 17 (Weds.) – Whetstone Mtns.

August 18 (Thurs.) – Patagonia Mtns.

August 20 (Sat.) – Lepto simultaneous count. Mtn. range??

August 22 (Mon.) – Huachuca Mtns. (Miller Canyon).

August 23 (Tues.) – Whetstone Mtns.

August 24 (Weds.) – Huachuca Mtns. (Miller Canyon).

Please note – This schedule will probably change several times throughout August and is dependent on bat activity and scheduling conflicts. In August I will be at the CNM the 1st 2 weekends (5-6 & 12-13) and FBNHS (26th) working on another grant (not related to the Lepto project) for bat inventory and monitoring.

Pit Tagging Protocol

1. Lay out all supplies to be used within easy reaching distance (i.e. swabs, betasept, glue, scissors, and pit tag).
2. Scan the bat to double check that it doesn't have a pit tag already.
3. Scan pit tag to confirm that the read-out number is the same one as printed on the label.
4. Wearing gloves, remove bat from cup and peel back the cloth bag so that the back half of the bat is revealed but the head is still covered. This will help keep the bat calm. By leaving the remaining bag tucked around the edges of the bat and by using the heel of your hand you should be able to keep the bat from squirming excessively. Inevitably you will handle a hell raiser though, so do your best to keep the animal stationary.
5. Carefully trim hair on the rump shorter (this doesn't need to be perfect). (**Note:** Avoid cutting the skin, it hurts and competes with the needle wound for healing time.)
6. Clean the area generously with betasept and a fresh swab three times.
7. Gently pinch the skin on the bats back into a fold about a centimeter up from the fur line along the top edge of the uropatagium and midway between the spine and side (what would be the rump of the bat) and lift. This action should cause the skin to tent and prevent the needle from accidentally being pushed into the muscle tissue below.
8. Softly push the needle into the middle of the tented skin fold. The needle should be pushed in far enough to ensure that the pit tag won't slip back out when ejected (this means that it must be slid in safely past the slanted opening of the needle by at least half of a centimeter). Depress the plunger on the needle to install the pit tag.
9. Remove the needle carefully and apply a small drop of Superglue or Nexaband to the opening while pushing the sides of the wound together. (**Note:** Be very careful not to glue yourself or a tool to the bat; the glue dries very fast.)
10. Hold the bat still for a few minutes to ensure that the glue is fully dried. Some people prefer to place a small amount of the trimmed hair on the glue as it sets not only for cosmetic reasons but also because it helps prevent the glue from sticking to the cloth bag when the bat is put back in.
11. Lift the bat up off of the bag and scan it to ensure that the pit tag is in the animal. (**Note:** In several cases, the needle was pushed in one side of the skin and came out the other side so that the tag was actually pushed out and fell into the bag. Thus, when the researcher scanned to check the pit tag a reading was acquired. By lifting the animal up out of the bag you can assure that this problem won't be a factor.) If the pit tag can be seen underneath the skin than you can ignore this last step. Make sure what you are seeing really is the pit tag though.
12. Breathe deep, after your third or fourth one this becomes "old hat".