BAT SPECIES RICHNESS AND ABUNDANCE AT THE CHIRICAHUA NATIONAL MONUMENT AND FORT BOWIE NATIONAL HISTORIC SITE
(7th year for the 10-year project)

Final Report for the 2006 Fieldwork

Prepared by:

Karen Krebbs (Principal Investigator)
Conservation Biologist
Center for Sonoran Desert Studies
Arizona-Sonora Desert Museum
Tucson, Arizona

October 2006

Prepared for:

The National Park Service,
Desert Southwest Cooperative Ecosystems Study Unit,
and The Arizona-Sonora Desert Museum.

Hoary bat on tree (Photo: Bob Graf)

ARIZONA-SONORA DESERT MUSEUM

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

EXECUTIVE SUMMARY

We carried out fieldwork in May, June, and August 2006, at the Chiricahua National Monument (ChrNM) and Fort Bowie National Historic Site (FBNHS) in southeastern Arizona. Year 2006 was the seventh year of an on-going ten-year project to monitor and inventory bats for the National Park Service (NPS). A total of ten evenings of netting were spent in the two monuments at five different water sources. One hundred fourteen bats of 11 species at ChrNM and seventeen bats of six species at FBNHS were captured in 2006. The netting sessions in May at the ChrNM were more productive for number of bats and species captured than the August netting. Bats appear to be more difficult to net at the ChrNM once the summer monsoon rains arrive in the Chiricahua Mountains. The summer monsoons produce standing water enabling the bats to disperse to other areas to drink and forage. During dry periods, bats tend to congregate at the few available water sources. The water source at the FBNHS (Apache Springs) is a permanent spring and the recent cleared areas around the water for fire prevention has opened this area to larger species of bats. At the FBNHS in August, we have netted several new species for that park and this may have resulted from the previous clearing in this area during 2005. Arizona's monsoon season in 2006 (July and August) resulted in above normal rainfall and water was abundant in the two parks. Water was observed in streambeds or standing in areas that are normally dry or much lower in volume. Bats were difficult to capture in August in both parks probably as a result of the above normal rainfall. We also began recording bat vocalizations at the study sites for further analysis.

In 2006, I trained two new people to help me with the project. Marie Long and Phil Brown (Arizona Sonora Desert Museum Employees) helped me during the ten evenings of bat netting. Bob and Anne Graf had helped me with this project from 2002 to 2005 and their help was much appreciated. The seventh year of fieldwork was completed by August 17, 2006, and the results are presented in this final report.

ACKNOWLEDGEMENTS

I want to thank the National Park Service, Desert Southwest Cooperative Ecosystem Studies Unit (Desert Southwest CESU), and the Arizona-Sonora Desert Museum (ASDM) for their support and financial contributions to this project. I also appreciate the support and input from Larry Norris. Alan Whalon, Ruth Olsen, Carrie Dennett, and Jeff Helmer have provided guidance, help, support, and made arrangements for camping and overnight accommodations after the evening netting. Arizona-Sonora Desert Employees Marie Long and Phil Brown helped with the bat netting and fieldwork. Several National Park Service Fire Fighters joined us for one evening of netting in May at the ChrNM to record data, bat vocalizations, and acoustics. I appreciate the opportunity to utilize Bob Graf's images. All other pictures are the property of Karen Krebbs.

Dr. Yar Petryszyn's input and expertise is appreciated. Janet Tyburec provided records for the BCI Bat Workshops (1992-2005) on the east side of the Chiricahuas for

comparison to my data. Tani Hubbard and Dr. Christine Conte helped edit the report. The Arizona-Sonora Desert Museum (ASDM) financial department staff (Kathryn Riser and Penny Poynter) oversaw all grant financial requirements and paper work. I also appreciate conversations with Dr. Virginia Dalton, Dr. Mark Dimmitt, Dr. Ronnie Sidner, Ruth Olsen, Tim Snow, Sherry Mann, and Janet Tyburec. Laurence Fahrney (Network Administrator) made the report available on-line for agency personnel to view or download, made helpful suggestions, and helped with computer problems. Dale Young scanned slides or downloaded digital images and these were utilized in the report. All the above people helped make this project successful and I thank them all.

INTRODUCTION

More than 950 different species of bats are known worldwide, making up about one-quarter of all living mammals. Bats are among the most diverse and geographically dispersed group of living mammals (Kunz 1988). Bats provide essential ecosystem services including flower pollination and seed dispersal. They are also the major predators of night flying insects. Given the large volumes of insects consumed (up to 100% of body weight per night) and the long distances traveled, these bats are thought to play a major role in regulating nocturnal insect populations and in transporting nutrients across the landscape, particularly from stream corridors to tree roosts (Rainey et al. 1992). Despite the great diversity of bat species around the world and in the United States, bats are poorly studied compared to other mammals. Since bats are secretive and often elusive, the most basic natural history and ecological information have not been studied or documented for many species. Increasingly bats are threatened by habitat destruction, fragmentation, pollution, pesticides, and human ignorance. Drastic reductions in bat populations have occurred during the recent years in the United States and worldwide (Harvey et al. 1999). As human population increases, more pressure is placed on natural resources and more bat habitat has been lost.

The Chiricahua Mountains lie at a meeting place of four ecosystems: the Sierra Madre to the south; the vast Chihuahuan Desert; the warmer Sonoran Desert; and the Rocky Mountains (Parent and Scott 1994). The Chiricahuas are the most massive mountain range in southeastern Arizona and harbor the largest forested area (Parent and Scott 1994). The Chiricahua Mountains encompass sizable acreages of oak and oak-pine woodland and lesser amounts of coniferous forests in Arizona and Sonora (Gehlbach 1993). The large size of the Chiricahua Mountains and its nearness to the Sierra Madre range in Mexico mean that a wide variety of bird, animal, and plant life found nowhere else in the United States can be seen here (Davis and Russell 1995). Many plants and animals of the Sierra Madre Occidental reach the northern limit of their range in the Chiricahuas (Parent and Scott 1994). The Chiricahua National Monument encompasses 12,000 acres and hosts a large variety of bird, animal, and plant life unique to this area. Twenty-three of the 44 species of bats that occur in the United States and Canada have been documented in the Chiricahuas. There are an additional 20 species of bats that occur in Mexico that are not common in the United States. Some of these Mexican species may be present in this mountain range. The high diversity of bat species in the Chiricahua Mountains is probably the result of a diversity of habitats and plants that

make up this area. The Fort Bowie National Historic Site in the Dos Cabezas Mountains also boasts a great diversity of mammals (Roth and Cockrum 1970).

A ten-year inventory and monitoring program for bats was initiated in 2000 at the ChrNM and in 2001 for the FBNHS. Most of the bat studies in the past have taken place on the east side of the Chiricahua Mountains and have not included the ChrNM on the western side of this mountain range. Bat Conservation International (BCI) carries out its yearly bat workshops at the American Museum of Natural History Southwestern Research Station on the east side of the Chiricahua Mountains (Tyburec 2004). The 1970 mammal survey by Roth and Cockrum at the FBNHS was the last study carried out for bats in the Dos Cabezas Mountains. Long-term studies can illustrate trends and indicate how bats respond to weather extremes like drought or wet periods in these mountain ranges. Results from bat species inventory and monitoring projects can help resource managers better manage their natural resources and the animals that depend upon these resources for their survival. It is also essential for managers to know what bat species occur in these areas. In 2006, we completed the seventh year (ChrNM) and the sixth year (FBNHS) for this ten-year bat study. We surveyed five different sites for bat species diversity at selected water sources within the two parks.

OBJECTIVES

1) Carry out a total of ten nights of netting for the ChrNM and the FBNHS in May, June, and August 2006.

2) Compare the previous years' netting at the ChrNM (2000-2005) and the FBNHS (2001-2005) to that of 2006.

3) Provide a final report to the NPS, Desert Southwest CESU, and the Arizona-Sonora Desert Museum by October 31, 2006.

METHODS

Ten evenings of netting were carried out at the ChrNM and the FBNHS in southeastern Arizona during May, June, and August 2006. Standard mist nets were utilized at five different water sources to capture bats in both parks. Bats normally use streams and washes as travel corridors and for drinking. Up to three separate 2.6 m nets were setup at each site and monitored from dusk until midnight. We collected data for weight, species, sex, reproductive condition, external parasites, and noted other physical traits for all bats captured (Tables 1-10). All data collected was recorded on data sheets and later entered into a table for the final report. Bats were released at the site of capture after the data collection. Each of the five water sources was inventoried for one evening for the ChrNM (May) and FBNHS (June) and the netting repeated in August for each site at both parks. One to two trained volunteers assisted in the nightly netting at each site.

Chiricahua National Monument

Bats were mist netted at four sites in May and August 2006 (Tables 1-10). These sites were also monitored for the same months in 2000, 2001, 2002, 2003, 2004, and 2005. The only reliable water site in May was Silver Spur Creek (SSC) since the other three sites were below normal for water levels or totally dry. We have never observed such low water levels as we did in May 2006. The four netting sites were: 1) Small Pool in the drainage parallel to the road, 225 m (250 yards) north of Bonita Canyon Campground (BCC), 2) "Old Pump" 2.4 km (1.5 mi) north of BCC, 3) "Big Rock and Small Stream" near Superintendent's House and south of BCC, and 4) Silver Spur Creek below the meadow and south of BCC. The "Big Rock and Small Stream" sites were totally dry in May. The "Small Pool" area had a small amount of water but was lower than in the past six years (2000-2005) for this project. During July and August 2006 an incredible amount of rain (Table 11) resulted from the summer monsoon and tropical depressions that filled creeks, dry bed streams, and other areas. We only captured one bat at the ChrNM in August.

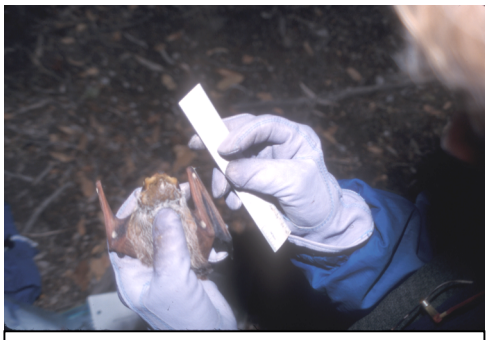

Photo 1: Data collection on a hoary bat (Photo: Karen Krebbs)

One site was netted per evening, and the netting sessions were carried out over two consecutive nights. One to four separate nets were set up at each site. The ends of the net were placed on 3 m (10 ft) poles (two-5 ft. poles on top of each other), hung over the water, and attached to another 3 m pole on the opposite side of the water.

The nets were opened as early as 1900 hours and closed as late as 2435 hours. Each location had at least two people processing the bat capture and count. Each bat caught in the net was processed immediately and released. We also recorded bat vocalizations for some of the bat species.

Fort Bowie National Historic Site

Bats were mist netted at Apache Springs in the FBNHS (Tables 5 & 10). Apache Springs is located between the Visitor Center and the Cemetery at FBNHS. This site was monitored for bats in 2001, 2002, 2003, 2004, and 2005. Apache Springs is a reliable source of water each year. Nets were set up at this site for one evening in June and August 2006. One to three nets were set up at this site. The nets were opened as early as 1900 hours and closed as late as 2330 hours. This site had two people processing bats and all bats were released after the data collection. In the past years (2001, 2002, 2003) we have only inventoried bats in June at the FBNHS. In 2004, we began to inventory bats in both June and August so that the data would be consistent with that for the ChrNM where we net bats before and after (or during) the summer monsoon rains.

RESULTS

Tables 1-10 present the raw data from the ten evenings of bat mist netting at the ChrNM and the FBNHS for 2006. Included in each table are the data that was taken on each bat captured in the nets. Tables 11-13 summarize the rainfall data for the ChrNM, ChrNM Bat Summary data for 2000-2006, and the FBNHS Bat Summary data for 2001-2006 for each year. Table 14 explains the abbreviations for bat species used in Figures 1-5 for both the ChrNM and the FBNHS. Over the past seven years, a total of 1,175 bats of 17 species (Tables 12 and 13) have been captured at the ChrNM and the FBNHS.

Chiricahua National Monument

A total of 114 bats of 11 species (Table 12) were captured at the ChrNM in 2006. During the past seven years, we have captured a total of 17 species (Figure 6) and 1,124 bats at the four netting sites in the ChrNM (Table 12, Figures 4, 6). We captured a new species (*Myotis lucifugus occultus)* at the ChrNM in 2006.

Fort Bowie National Historic Site

At the FBNHS, a total of 17 bats of six species (Table 13) were captured over two evenings in 2006. Over the past six years, we have captured nine species (Figure 7) and 51 bats at the FBNHS (Table 14, Figures 5, 7). One species (*Myotis lucifugus occultus)* captured at Apache Springs in the FBNHS, had never been captured at the CNM until 2006 for this inventory project. In 2005, we captured two new species (*Leptonycteris curasoae* and *Corynorhinus townsendii)* to this area (Table 13). In 2006, we captured more individual bats (17) than we had for any year in the past.

Photo 2: Townsend's big-eared bat (Photo: Bob Graf).

DISCUSSION

We accomplished all of our objectives for the 2006 bat inventory and monitoring program at the ChrNM and the FBNHS. Year 2006 was another exciting year for the ten-year bat monitoring and inventory project at the two parks. We carried out ten evenings

of netting at five different water sources in the ChrNM and the FBNHS in southeastern Arizona. The months of May and June were hot and dry in these areas. The amount of water at the netting sites appeared lower than for the previous years, with the exception of Apache Springs (FBNHS) and Silver Spur Creek (ChrNM), which are permanent springs. Our 2006 data indicated that this years' number of bats captured was exceeded by four other years (2002-2005) for the highest in number of bats captured for the past seven years (Table 12) at the ChrNM. The number of bats captured in August 2006 (one bat) at the ChrNM was lower than in any of the past years and was probably due to the massive amounts of rainfall during the yearly monsoon period in July and August (Table 11).

We continue to experience a drought in Arizona (Dimmitt pers. com.) even after the above normal rainfall for 2006 in the summer months in Arizona. The water sources at both parks had shrunk (or were totally dry) in three of the five study areas during the May and June bat netting. Bats utilize water sources for drinking, to catch insects, and as travel corridors. Bats appear to congregate at water sources during drier periods and when water is not as abundant. Insects also seek out areas of standing water during periods of drought and when water is scarce. Bats have been more difficult to capture (results from this study) when there is more water available (Table 11-13 and Figure 8). Bats have more options for water sources in wet years. The bat netting attempts in August at the ChrNM (Tables 6-9) were interrupted by rain, weather extremes, and above normal levels of water and bats were harder to capture on these evenings. Only one bat was captured at the ChrNM in August over a period of four evenings.

Apache Springs (AS) at the FBNHS is a reliable, year-round spring, and until this year we had not noticed a large difference in the number of bats or species captured over the past four years. Before 2005, the vegetation was thick and dense around AS and we had never captured species other than myotis. Larger bats may not been able to maneuver in this crowded space and this may explain why larger species have not been captured at this site before 2005. In the spring of 2005, the NPS cleared out much of the vegetation around the spring at FBNHS. Opening this area probably allowed larger species like *Leptonycteris curasoae* and *Corynorhinus townsendii* (Table 13, Krebbs 2005) sufficient space to drink water at this spring. We captured more bats during the June netting at AS than for any of the previous five years. The continued drought situation and clearing of vegetation in this area may have improved our chances of capturing more individual bats in June 2006 during the dry periods.

We captured more than 200 bats at the ChrNM in each of 2003 and 2004. This is almost more than twice as many bats captured for each of the previous three years. The extended drought may have contributed to the high number of bats captured in 2003 and 2004. In 2005, we captured a total of 195 bats at the ChrNM and probably would have netted a higher number of bats if rain had not spoiled several of the netting sessions. In 2006, a total of 114 bats were captured at the ChrNM and was lower than the previous four years but the capture of only one individual bat in August contributed to this lower number. Water sources have appeared to shrink each year in the ChrNM (personal observation) even though all four netting sites retained some water until August 2005. During the past few years, we have not used the larger nets over the water because the

smaller net (2.6 m) has been adequate for the shrinking water sites. At the ChrNM in May 2006 we placed nets over the dry streams and areas of lower water levels since bats will use these areas as highways but captured only a few bats (Table 1 & 3). For 2007, it will be interesting to see if water levels at these sites have increased after the above normal monsoon season this past summer or will it require several more above normal monsoons to replenish the low water levels.

The number of species captured at the ChrNM in 2006 (11) was the lowest for all the seven years (Table 12). We did not capture any *Leptonycteris curasoae, Choeronycteris mexicana, Idionycteris phyllotis, Lasiurus cinereus,* or *Myotis velifer* as we have in the past years (Krebbs 2005). But we did capture a new species (*Myotis lucifugus occultus)* for the ChrNM that had not been netted in this park for this project. The last time we had captured a new species in this park was in 2003, when we captured *Lasiurus blossevillii* (Table 12). While this bat (red bat) has been captured in the Chiricahuas on the east side by BCI (Tyburec 2004) and in early inventories (Cockrum and Ordway 1959), captures of this species are unusual. We captured three *L. blossevillii* (2 males and 1 female) in May 2003 (Table 12). Not a lot is known about red bats in Arizona but in California the sexes segregate during spring and summer (Monday 1993). In California, females remain in lowland areas, whereas males apparently move to higher elevations (Cryan 2003). In Arizona, the red bat is thought to be a summer resident only (Monday 1993). We have not captured additional *L. blossevillii* over the past three years.

Photo 3: Allen's lappet-browed bat with ears down (Photo: Bob Graf)

In 2005, we captured *Leptonycteris curasoae* (lesser long-nosed bat) in both parks (Table 12 & 13) but this endangered bat is not captured each year. Netting a lesser long-nosed bat at the FBNHS in 2005 was a new species for that area and this study. At the FBNHS there are agave plants for the endangered bat to forage on and we felt that this species was definitely in this area. In the past we have netted young male lesser long-nosed bats at the ChrNM but both bats captured in 2005 were adult females. One of these females was post lactating and the other did not have noticeable nipples. We did not catch *L. curasoae* in either park for 2006. We captured two female *Choeronycteris mexicana* (Mexican long-tongued bat) at the ChrNM (Table 12) at the beginning of August 2005 and both were lactating but this species was not captured in 2006. Both of the nectar bat species (*L. curasoae* and *C. mexicana)* have only been netted in the August months for this project. It is interesting that we captured *Idionycteris phyllotis* (Allen's lappet-browed bat, Photo 3) in 2000, 2001, 2002, and 2005 but not in 2003, 2004, or 2006. This is an exciting species to capture because it has not been netted often in the Chiricahua Mountains for this study.

Large numbers of the tree bat, *Lasionycteris noctivagans,* were netted at the ChrNM in 2003 and 2004, compared to the prior three years but captures dropped

drastically in 2005 and 2006 (Table 12). In 2003, we captured 46 *L. noctivagans* (silver-haired bat) and in 2004 we captured 37 at the ChrNM. In 2005, only 15 silver-haired bats were netted and 3 in 2006 (Table 12). All the *L. noctivagans* were captured in May and not in the August netting sessions. We netted one silver-haired bat in the June 2005 during a make-up session at the ChrNM. *Lasionycteris noctivagans* is considered to be a highly migratory (Barbour and Davis 1969) bat and perhaps explaining why this species was captured in May and June. Previous studies or reports for this species in the Chiricahua Mountains (Allen 1895, Cockrum and Ordway 1959, Cahalane 1939, Hoffmeister 1986, Schmidt and Dalton 1994) indicate that it is primarily netted in May and June in the summer and during the winter months in this area.

Schmidt and Dalton (1994) state there have never been any gravid female *L. noctivagans* captured in Arizona. We netted two gravid females in May 2003 (2003 report, Table 2), which may be the first evidence that pregnant females do occur in the Chiricahuas. These are the only females of this species that we have ever captured in the Chiricahuas for this study but there may be more females present in this mountain range during this time. These two females may have been migrating through this area to more northern altitudes. Absence of female *L. noctivagans* from mountainous regions of western North American during summer might reflect their inability to raise young under the climatic conditions and relatively low productivity experienced in these regions (Cryan 2003). We have never captured this species in August and their presence in other areas of the Chiricahua Mountains in the middle of June, suggests that this species of bat shows seasonal altitudinal migration (Cockrum and Ordway 1959). Our data (2003 and 2004 Yearly Reports) at this time supports the seasonal altitudinal migration of *L. noctivagans*. I think that timing (and luck) is important to the success of capturing numerous silver-haired bats in the Chiricahua Mountains during the summer.

For the past seven years, with the exception of 2002 and 2006, we have captured *Lasiurus cinereus* (hoary bat) at the ChrNM. Hoary bats roost in the foliage of trees and are considered one of Arizona's tree bats (Monday 1993, cover photo). All five hoary bats captured in May 2005 were males but five pregnant females were netted in May 2004 at the ChrNM. It would be difficult to say if these females were resident or migrating through our area for more northern latitudes. It is not known if young are born in Arizona and we have not captured any lactating females during this project. Females have been taken in Arizona in April, May, July, August, October, and December (Hoffmeister 1986). Hoffmeister thinks that females are present longer in Arizona than just migrating through the state in April and May. In southeastern Arizona hoary bats may be present year-round (Hoffmeister 1986). We rarely net hoary bats in August but it is difficult to capture most of the species of bats during this month when water is more plentiful. August 2006 is an excellent example of how difficult bats are to capture during periods of higher than normal rainfall.

In 2006, we only captured a total of six *Corynorhinus townsendii* (Townsend's big-eared bat) at the two parks (Table 12). Past data (2004-2005) indicates that many of these bats were pregnant females and may indicate that a maternity colony of *C. townsendii* exists in this mountain range. In 2006, we captured 3 pregnant females (Table

2, 4). Females congregate in maternity colonies of 12 to several hundred individuals in the spring and summer, whereas the males tend to be more solitary (Monday 1993). Previous studies or mine checks from 1939 to 1955 of the Virtue Mine and Crystal Cave in the Chiricahua Mountains by Cahalene, Cockrum, and Bogert found clusters of pregnant *C. townsendii* (Cockrum and Ordway 1959). *Eptesicus fuscus* (big brown bat) is a species we commonly capture in the nets and over the past three years (2003-2005) we have netted more than twice the number we usually capture and in 2006 we netted more than for 2000, 2001, and 2002 (Table 12). Big brown bats are commonly associated with buildings in eastern North America but appear to depend more on tree cavities in western North America (Kunz and Fenton 2003). *Myotis thysanodes* (fringed myotis) is the species of bat we have consistently captured large numbers of more of than any other species at the ChrNM (Table 12 & Figures 2, 4) except that in 2006 we netted fewer individuals than any of the past years. Records from the BCI workshops at Portal indicate that the *Myotis californicus* (California myotis) is the bat species that is captured more often on the east side of the Chiricahua Mountains (Tyburec 2004). *Myotis californicus* and *Myotis auriculus* (Southwestern myotis) are the second most common species of Myotis (Figures 2, 4) that we capture at the ChrNM.

Photo 4: Data collection on a silver-haired bat (Photo: Karen Krebbs).

Rainfall differences or changes in the Chiricahua Mountains over the past few years have probably affected the number of bats captured (Figure 8). It appears that the lack of rainfall in this area results in an increase in bat numbers around water sources (personal observation). As the amount of rainfall decreases, the number of bats captured in our nets increases (Figure 8). Bats utilize water sites for capturing insects and as a source of drinking water. The scarcity of water in the Chiricahua Mountains during the drier months could be a limiting factor for bats in this area. Bats are mobile (flight) and have the advantage of being able to move to other areas in a short time if a resource such as water is unavailable to them. Bats are the only mammals that have sustained flight (Nowak 1994). Unfortunately, bats that are forced to move to more favorable areas in search of water may have negative effects on resident populations of bats. Bird populations "erupt" (departure of birds from their normal range) when food sources change or are unavailable for the birds (Weidensaul 1999). This results in increased competition for food sources for the resident populations of birds. The same may be true for bat populations that have to share a shrinking water source or move to other areas in search of additional water. The above normal rainfall in July and August in Arizona resulted in fewer individual bats captured over five evenings at both of the parks. We only captured two bats of two species during the August netting. In August 2006, I observed more water and swollen streams in areas that I had not seen in the past six years.

During the netting sessions in May 2005 at the ChrNM we captured an *Otus trichopsis* (whiskered screech-owl) at the same time and in the same pocket of the net as

a *Myotis ciliolabrum* (western small-footed myotis bat). We even found the owl trying to grab the bat with a talon while entangled in the net. I think it is safe to conclude that the owl was chasing the bat when both were captured in the net. We have captured whiskered screech-owls in our nets in previous years but caught none in 2006. In August 2005, we observed a large owl sitting close to one of our nets at the pump site in the ChrNM. We identified the owl as *Strix occidentalis* (spotted owl) and 45 minutes after first observing the owl it stumbled into our nets. Despite the fact that owls and other raptors prey upon flying bats, and that some snake species prey on individuals as they leave the roost site, when bats are foraging they are typically too aware, evasive, and fast to be at risk (Adams 2003). It was obvious from observing the two species of owls during our netting in 2005 that they were hunting bats at the ChrNM. The presence of the spotted owl at the pump site was within one of the designated owl PACS but the NPS has not observed or carried out surveys for this species in that area for several years (Olsen pers. comm.). During the May 2006 netting we observed another spotted owl as it sat in a tree close to the nets. It may have been the same individual that we observed in 2005 but this owl did not get entangled in our nets in 2006. We usually observe several *Ursus americanus* (black bear) during our field season at the ChrNM but saw none of these bears this year.

In May 2006, several of the water sources at the ChrNM were dry or lower than for the past six years. The drought period over the past several years for Arizona may be having a negative impact upon water sources despite the current rainfall increases. July and August 2006 in Arizona had an above average monsoon rainfall. In Tucson during the summer monsoons, we received just short of 12 inches (30.5 cm) of rainfall. Twelve inches of rain in Tucson is usually the amount of rainfall we receive for the entire year. Most of the mountains of southeastern Arizona received far more rain than the lower Sonoran Desert. Coronado National Memorial in the Huachuca Mountains obtained massive damage to roads and terrain during the summer (Mann pers. com.). I observed numerous dams of vegetation, logs, and downed trees in the Chiricahua National Monument and the Apache Springs (FBNHS) area flooded during the rains. Will this increase in the summer rainfall affect the study site water levels in the Chiricahua and Dos Cabeza Mountains in 2007? Will the sites that have been dry for the past few years see a renewed water level? It may take additional above average monsoons or winter rain seasons to improve the negative affects of the long-term drought in Arizona. A long-term inventory and monitoring projects allow us to examine temporal and spatial population shifts in relation to environmental and climatic change. Finding rare or new species, such as the red bat or occult little brown bat, or detecting population response to drought and flooding would not be possible in a short-term study. Shifting trends in seasonal migration patterns are also more likely captured in long-term studies like the large numbers of male silver-haired bats found in May 2003 and 2004 during this study. Capturing numerous pregnant Townsend's big-eared bats in 2004 and 2005 at the ChrNM emphasis the importance of protecting maternity roosts. Our data provides a tool that resource managers and biologists can utilize to help fill in gaps of knowledge for bat species in the Chiricahua Mountains. We will continue our study at the ChrNM and FBNHS in 2007.

LITERATURE CITED

Adams, R.A. 2003. *BATS of the Rocky Mountain West: Natural History, Ecology, and Conservation.* University Press of Colorado.

Allen, J.A. 1895. On a collection of mammals from Arizona and Mexico, made by Mr. W.W. Price, with field notes by the collector. Bull. Amer. Mus. Nat. Hist., vol. 7, pp. 193-258.

Barbour, R.W. and W.H. Davis. 1969. *Bats of America*. University Press of Kentucky, Lexington.

Cahalane, V.H. 1939. Mammals of the Chiricahua Mountains, Cochise County, Arizona. Journal of Mammalogy 20:418-440.

Cockrum, E.L. and E. Ordway. 1959. Bats of the Chiricahua Mountains, Cochise County, Arizona. Am. Mus. Novitates 1938, 35 pp.

Cryan, P.M. 2003. Seasonal Distribution of Migratory Tree Bats (*Lasiurus* AND *Lasionycteris)* in North America. Journal of Mammalogy 84(2):579-593.

Davis, W.A. and S.M. Russell. 1995. *Finding Birds in Southeastern Arizona*. Tucson Audubon Society, Tucson, AZ.

Gehlbach, F.R. 1993. *Mountain Islands and Desert Seas.* Texas A & M University Press.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 1999. Bats of the United States. Arkansas Game & Fish Commission.

Hoffmeister, D.F. 1986. *Mammals of Arizona*. Univ. of Ariz. Press, Tucson. 602 pp.

Krebbs, K. 2005. Bat Species Richness and Abundance At The Chiricahua National Monument and Fort Bowie National Historic Site. Technical Report for the NPS.

Kunz, T.H. (ed.). 1988. Behavioral and Ecological Methods for the Study of Bats. Smithsonian Institution Press, Washington, D.C.

Kunz, T.H and M.B. Fenton (eds.). 2003. *Bat Ecology.* The University of Chicago Press, Chicago and London.

Monday, D.C. (ed.). 1993. *Bats of Arizona* in *Arizona Wildlife Views.* Special Heritage Edition, Publication of Arizona Game and Fish Department, Vol. 36, # 8.

Nowak, R.M. 1994. *Walker's Bats of the World.* The John Hopkins University Press, Baltimore and London.

Parent, L. and S. Scott (ed.). 1994. *Chiricahua National Monument.* Southwest Parks and Monuments Association, Tucson, Arizona.

Rainey, W.E., E.D. Pierson, M. Colberg, and J.H. Barclay. 1992. Bats in hollow redwoods: Seasonal use and role in nutrient transfer into old growth communities. Bat. Res. News 33(4):71.

Roth, E.L. and E.L. Cockrum. 1970. A Survey of the Mammals of the Fort Bowie National Historic Site. Technical Report for the National Park Service, AZ.

Schmidt, S.L. and D.C. Dalton. 1994. "Biodiversity and Management of the Madrean Archipelago: The Sky Islands of Southwestern United States and Northern Mexico," USDA Forest Service, General Technical Report RM-GTR-264.

Tyburec, J. 2004. Portal Arizona Bat Capture Summary for 1992 to 2004. Bat Conservation International Bat Workshops in Southeastern Arizona.

Weidensaul, S. 1999. *Living on the Wind Across the Hemisphere with Migratory Birds.* North Point Press, New York.

Weldon, H. 1993. *The Chiricahua Sky Island*. Marguerite Bantlin Publishing.

Photo 5: Rainbow in Chiricahua Mountains after storm (Photo: Karen Krebbs)