BAT SPECIES RICHNESS AND ABUNDANCE AT THE CHIRICAHUA NATIONAL MONUMENT AND FORT BOWIE NATIONAL HISTORIC SITE
(9th year for the 10-year project)

Final Report for the 2008 Fieldwork

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Pallid Bat (*Antrozous pallidus)* in hand.

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EXECUTIVE SUMMARY

We carried out fieldwork in May, June, July, and August 2008, at the Chiricahua National Monument (ChrNM) and Fort Bowie National Historic Site (FBNHS) in southeastern Arizona. Year 2008 was the ninth 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 eighty-two bats of 12 species at ChrNM and 27 bats of 4 species at FBNHS were captured in 2008. The netting sessions in May and June at the ChrNM and FBNHS are usually more productive for number of bats and species captured than the July or August netting. Bats appear to be more difficult to net at the two monuments once the summer monsoon rains arrive in these mountain ranges. 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 there is usually water at this site all summer. The recent vegetation clearing and floods of 2006 at Apache Springs has opened this area to larger species of bats. Arizona's monsoon season and rainfall in 2008 (July and August) appeared normal (or above normal) and water was abundant in the ChrNM. At the FBNHS, Apache Springs was well below normal in water volume (personal obs.) during the August fieldwork. We captured fewer bats during the July and August netting supporting the theory that bats are more difficult to capture in July and August in both parks probably as a result of the monsoon rainfall.

In 2008, I trained (or continued training) three people to help me with the fieldwork. Phil Brown, Brenda King (Arizona Sonora Desert Museum Employees) and Starlight Noel (Arizona-Sonora Desert Museum volunteer) helped me during the ten evenings of bat netting. Brian Carey (Superintendent of ChrNM) and Cathy Spellman helped with the fieldwork for several evenings. The ninth year of fieldwork was completed by August 4, 2008, and the results are presented in this final report.

ACKNOWLEDGEMENTS

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(ASDM) financial department staff (Kathryn Riser and Penny Poynter) oversaw all grant financial requirements and paperwork. I appreciate the support of Robert Edison, Dr. Richard Brusca, Dr. Christine Conte, Dr. Debra Colodner, and Marie Long. I also appreciate conversations with Angie McIntire, Tim Snow, and Janet Tyburec. Barbara Yates and Beth Rice helped with the report copies. All the above people helped make this project successful. All photos are the property of Karen Krebbs. It is always a pleasure to work in these parks and I appreciate the opportunity to do so.

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 has not been studied or documented for many species. 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, Weldon 1993). 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 Cabeza Mountains also boasts a great diversity of mammals (Roth and Cockrum 1970).

A ten-year on-going inventory and monitoring program for bats was initiated in 2000 at the ChrNM and in 2001 for the FBNHS. Many of the bat studies carried out 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 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 2008). 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 identify 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 2008, we completed the ninth year (ChrNM) and the eighth 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 evenings of netting for the ChrNM and the FBNHS in May, June, July, and August 2008.

2) Compare the previous years' netting data at the ChrNM (2000-2007) and the FBNHS (2001-2007) to that of 2008.

3) Provide a final report to the NPS, Desert Southwest CESU, and ASDM by November 28, 2008.

METHODS

Ten evenings of netting were carried out at the ChrNM and the FBNHS in southeastern Arizona during May, June, July, and August 2008. Standard mist nets were utilized at five different water sources to capture bats in both parks. Up to three separate 2.6 m or 6 m nets were set up 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 July or August for each site at both parks. One to two trained volunteers assisted in the nightly netting at each site. Brian Carey (Superintendent of ChrNM) and Cathy Spellman helped with several of the netting sessions.

Chiricahua National Monument

Bats were mist netted at four sites in May, June and July 2008 (Tables 1-10). The netting site at the stream north of the Bonita Canyon Campground was totally dry in May. All four netting sites contained water in July and August. The four netting sites were: 1)

Small Pool in the drainage parallel to the road, 228 m (249 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 park offices and south of BCC, and 4) Silver Spur Creek below the meadow and south of BCC. The drainage at the "Small Pool" site has been changed because of the 2006 floods.

One site was netted per evening. Two to three 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 2430 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, 2005, 2006, and 2007. Apache Springs has been a reliable source of water each year but recently the volume of water has decreased. Nets were set up at this site for one evening in June and August 2008. Two nets were set up at this site. The nets were opened as early as 1900 hours and closed as late as 2300 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 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 2008. Included in each table are the data that was taken on each bat captured in the nets. Tables 11 to 15 summarizes the rainfall data for the ChrNM, ChrNM bat summary data for 2000-2008, FBNHS bat summary data for 2001-2008, abbreviations, and netting location data. Table 14 explains the abbreviations for bat species and netting locations used in Figures 3, 4, and 6 for both the ChrNM and the FBNHS. Over the past nine years, a total of 1,571 bats of 17 species (Tables 12 and 13) have been captured at the ChrNM and the FBNHS.

Chiricahua National Monument

A total of 182 bats of 12 species (Table 12) were captured at the ChrNM in 2008. During the past nine years, we have captured a total of 17 species (Figure 6) and 1,467 bats at the four netting sites in the ChrNM (Table 12, Figure 6). We captured a new species (*Myotis lucifugus occultus)* at the ChrNM in 2006 and again in 2007. We had not

captured the Allen's lappet-browed bat (*Idionycteris phyllotis)* since 2005 but netted one male in July 2008 (Table 12, Figure 3a).

Fort Bowie National Historic Site

At the FBNHS, a total of 27 bats of four species (Table 13) were captured over two evenings in 2008. Over the past eight years, we have captured 9 species (Figure 4) and 121 bats at the FBNHS (Table 13, Figures 2, 4). In 2005, we captured two new species (*Leptonycteris curasoae* and *Corynorhinus townsendii)* to this area (Table 13). In August 2007, our netting efforts only produced one bat (*Leptonycteris curasoae)*. In 2007, we captured more individual bats (43) than we had for any year in the past (Table 13). Cave myotis (*Myotis velifer,* Photo 2*)* appears to be the most numerous bat species captured (Table 13) in this area over the past eight years.

Photo 2: Cave myotis (*(Myotis velifer)* in hand.

DISCUSSION

We accomplished all of our objectives for the 2008 bat inventory and monitoring program at the ChrNM and the FBNHS. Year 2008 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. Our 2008 data at the ChrNM indicated that this years' number of bats captured was only exceeded by three other years (2003-2005) for the highest in number of bats captured for the past eight years (Table 12). Year 2008 was an excellent year for bat captures and species.

We continue to experience a drought in Arizona even after the above normal rainfall for 2006 (Table 11), an excellent monsoon season for 2007, and a good monsoon season for 2008 in the summer months in Arizona. In 2006, three of the five study areas were dry during the May and June bat netting but only one site was dry (Table 1) during May 2008. 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.

Photo 3: Allen's lappet-browed bat (*Idionycteris phyllotis)* in hand.

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 (Figure 5). Bats have more options for water sources in wet years. The bat netting attempts during the last week of July 2008 at the ChrNM (Tables 6-9) produced bats at all the netting locations

Until recently, Apache Springs (AS) at the FBNHS has been a reliable year-round water source. The floods of 2006 and recent clearing of vegetation (2005-2006) has open the area and allowed larger species like lesser long-nosed and Townsend's big-eared bats (*Leptonycteris curasoae yerbabuenae, Corynorhinus townsendii,* Table 13*)* to utilize this drainage. 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. Opening this area probably allowed the larger species (Table 13, Krebbs 2005 NPS Report) sufficient space to drink water at this spring. In 2007, there was a noticeable difference in water levels at AS. The spring has not been as reliable as in past years. In 2008, there was more water volume in June than for August (Table 5 & 10) but the water level was low for both months. For the past two years, we have captured more cave myotis bats than for any other species. There is a maternity roost for this species in the ice cave at the fort and it appears that this species is utilizing the water at AS. Since the water volume is lower now at AS, the other species of bats may be drinking at another water source.

We captured more than 200 bats at the ChrNM in each of 2003 and 2004 (Table 12). 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 utilized the larger nets over the water sources since the smaller net (2.6 m) has been adequate for the shrinking water sites. At the ChrNM in May 2008 (Table 1), the Small Stream location was the only netting site that was totally void of water during the fieldwork.

At the ChrNM in 2008, we did not capture any lesser long-nosed*,* Mexican long-tongued *(Choeronycteris mexicana),* hoary *(Lasiurus cinereus),* Western red (*Lasiurus blossevillii),* or occult little brown (*Myotis occultus)* bats as we have in the past years (Table 12). But we did capture an Allen's lappet-browed bat (Table 12, Photo 3) and the last time we netted this species was in 2005. This is an exciting species to capture because it has not been netted often in the Chiricahua Mountains for this study. When we do capture the nectar bats (lesser long-nosed & Mexican long-tongued) it is always during the latter part of the summer (August).

For the past seven years, and with the exception of 2002, 2006, and 2008, we have captured hoary bats at the ChrNM. Hoary bats roost in the foliage of trees and are

considered one of Arizona's tree bats (Monday 1993). 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 states that females are present longer in Arizona than for bats that are 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.

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 from 2005 to 2008 (Table 12). In 2003, we captured 46 silver-haired bats (L. noctivagans) 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 silver-haired bats were captured in May and not in the August netting sessions. We captured 19 male silver-haired bats in May for 2008. Silver-haired bats are considered to be a highly migratory (Barbour and Davis 1969, Cryan 2003) 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.

Photo 4: Brenda King (left) & Phil Brown (right) at the ChrNM.

Photo 5: Starlight Noel with a bat at the ChrNM.

At the ChrNM in both 2007 and 2008, we captured eight Townsend's big-eared bats (*Corynorhinus townsendii,* Table 12) for each year. Past data 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 (2006 yearly report). 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). The big brown bat is a

species we commonly capture in the nets and in 2008 we netted 37 of this species (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). The fringed myotis (*Myotis thysanodes)* is a species of bat that we have consistently captured large numbers but we have captured lower numbers since 2006 (Table12). Records from the BCI workshops at Portal indicate that the California myotis (*Myotis californicus)* is the bat species that is captured more often on the east side of the Chiricahua Mountains (Tyburec 2008). On the west side of the Chiricahua Mountains, we usually capture more southwestern myotis (*Myotis auriculus)* and fringed myotis than for the California myotis (Table 12).

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 5). 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. In 2008, the rainfall appeared normal (or above normal) at the ChrNM and we captured more bats than in 2006 and 2007 (Table 12).

In May 2008, several of the water sources at the ChrNM were dry or lower than for past years. The drought over the past several years in Arizona may be having a negative impact upon water sources despite the current rainfall increases. At the ChrNM, from April to August 2008, the amount of rainfall exceeded that of the previous eight years (Table 11). In 2008, we also captured more bats than for five earlier years. 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, Allens' lappet-browed, 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. We capture fewer California myotis on the west side of the Chiricahua Mountains (ChrNM) than researchers on the east side of the mountain (BCI workshop records) probably indicating some differences for this species in this mountain range. Our data provides a tool that resource managers and biologists can utilize to help fill in gaps of knowledge for natural

history, migration, movements, and population dynamics for bat species in the Chiricahua and Dos Cabeza Mountains. We will continue our study at the ChrNM and FBNHS in 2009.

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Photo 6: Brian Carey (right) & Kathy Spellman (left) at the "Old Pump" study site in the ChrNM.

Photo 7: Silver-haired bat (*Lasionycteris noctivagans)* in hand.