

**Spotted and Western Mastiff Bat Roost Study of the North
Kaibab Ranger District (Coconino County, Arizona)**

Final Report for IIPAM Heritage Grant I96003

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M.S. Siders, and R. Steffensen

INTRODUCTION

Once thought to be extremely rare, spotted bats (*Euderma maculatum*) are seldom abundant but are widely distributed throughout western North America and probably have a discontinuous, patchy distribution (Fenton et al., 1987; Nagorsen and Brigham, 1993). Much of what is known of spotted bat behavior and ecology has been gained from three locations where they are relatively common: the Okanagan Valley in southern British Columbia, Canada (Leonard and Fenton, 1983), Big Bend National Park in southern Texas (Easterla, 1970), and Fort Pierce Wash on the Utah-Arizona border (Ruffner et al., 1979). High cliffs were nearby in all three of these areas. Radio tracking of 3 spotted bats in British Columbia (Wai-Ping and Fenton, 1989) found that bats foraged all night and did not travel farther than 10 km from day roosts in cliffs. Preferred foraging habitat appears to be open areas surrounded by ponderosa pines (Woodsworth et al., 1981; Leonard and Fenton, 1983; Wai-Ping and Fenton, 1989).

Greater western mastiff bats (*Eumops perotis*) were thought to be extinct from the state of Arizona until we captured eight in 1995 resulting in a range expansion for the species (Castner et al., 1996). Roost sites have been described for California (Cockrum, 1960; Dalquist, 1946; Howell and Little, 1924), Texas (Ohlendorf, 1972) and Arizona (Cox, 1965). In general they live in high, dry places, but they cannot fly from the ground, so all roosts are in locations that allow the bat to drop 3 m to launch into flight (Freeman, 1981). In the southwestern United States, it is most common in rugged rocky canyons and cliffs (Barbour and Davis, 1969; Dalquest, 1946). Little is known about the foraging habitat for this species.

Spotted bats have been netted in only a few locations in Arizona and are a Forest Service Sensitive Species. Greater western mastiff bats are even more rare in Arizona and are a State Species of Special Concern. One maternity roost was known to exist near Kingman, but has not been occupied since 1962 (Mike Rabe pers. comm.). Because of their apparent scarcity, very little is known about the life history, habitat requirements or roosting behavior of these animals. The Arizona Game & Fish Department (AGFD) conducted bat surveys on the North Kaibab Ranger District (NKR) in conjunction with District Wildlife personnel in 1994, 1995 and 1996. These surveys documented the high diversity of bat species on the Kaibab Plateau and the presence of both spotted bats and greater western mastiff bats, considered to be rare species in Arizona. In 1995, six of seven captured spotted bats were transmittered. One bat was tracked to a cliff face in Oquer Canyon, but the actual roost was not determined. In 1996, six of ten captured spotted bats were radio tracked and one maternity roost was located in Grand Canyon National Park (GCNP) during an aerial survey (Rabe et al., in press).

While trapping for spotted bats in 1995, eight greater western mastiff bats were caught during a 30 minute stretch starting not long after sundown (Castner et al., 1996). Since these eight were captured relatively early in the evening (60 to 100 min after sunset), we thought that we were probably near a roost site. The presence of six lactating females and the earliness of the captures lead us to believe that there was a maternity roost near the trap site. Since the last known mastiff roost in Arizona had been unoccupied since the 1960s, we thought it important to try to find the roost. We placed transmitters

(BD-2, Holohill) on the six lactating females and attempted to follow, but no roost was located. In 1996, six western mastiff bats were caught, but none were radio-tracked.

The purpose of this project was to collect baseline population data on the spotted and western mastiff bats, to locate roost sites (primarily maternity roosts), and to locate sensitive foraging and watering areas. The information gathered through this project will provide further information that may be used to determine the current status of these species in Arizona and more specifically on the Kaibab Plateau. What is learned about the spotted and western mastiff bats on the North Kaibab will also be integrated into the District's land management planning, to ensure that the needs of these rare species are considered fully.

This report includes the results of 1997 bat surveys only.

STUDY AREA

The NKRK is located in far northern Arizona, on the northern boundary of the Grand Canyon National Park (Fig. 1). The district contains the Kaibab Plateau (coniferous forest), House Rock Valley (low elevation grassland) to the east and Winter Range (low elevation grassland) to the west. The Kaibab Plateau is a limestone formation out of which water has cut many drainages and steep canyons. Cover types include grasslands, pinyon-juniper (*Pinus edulis-Juniperus utahensis*), Ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), aspen (*Populus tremuloides*), spruce-fir (*Picea engelmannii-Abies lasiocarpa*), miscellaneous hardwoods (*Quercus* sp., *Acer* sp., *Robinea* sp.), blue spruce (*Picea pungens*) and Douglas fir (*Pseudotsuga menziesii*). Water is scarce, available only from a few springs, small natural lakes and stock tanks.

METHODS

Radio Telemetry

Spotted and western mastiff bat capture was conducted using mist nets at seven sites on the NKRK (Fig. 2). All net sites were over water in lakes or stock tanks. Netting occurred between 30 June and 21 August 1997 (Appendix 1). Radio transmitters (Holohil Systems Ltd., Model BD-2, 0.67 g for spotted bats, 1.2 g for mastiff bats) were attached to female bats (priority given to ones that were lactating) deemed healthy (by body weight) and able to carry the extra weight of the transmitter (See Snow et al. 1996). Then each bat was released. Spotted bats were followed to their foraging areas and roost location. Due to their fast flight speeds, mastiff bats were held until early morning (0400) before being released and were then followed by plane to their roost site. The bats were tracked until the transmitter battery failed (about 10-14 days) or until the transmitter fell off.

Two methods of radio-tracking were used to find bat locations: ground tracking in vehicles (at fixed points and from moving vehicles) and aerial surveys. Aerial surveys were used to pinpoint daytime roost locations of spotted and western mastiff bats after general locations were determined from ground telemetry.

Light Trapping

A light trap was set up from approximately 20:00-03:00 MST for seven nights, two nights at each site where spotted bats were captured and one night at an additional trap site. The insects were then sent off

to be identified. Collection and identification of available insect prey will hopefully lead to some speculation as to why these bats travel so far from their roosts to forage.

RESULTS

The presence of many audible (low frequency) spotted bat echolocation calls and feeding buzzes (increased rates of echolocation calls associated with insect detection and pursuit; Griffin et al., 1960) in the meadows indicated that spotted bats were locally common and the meadow systems were heavily used as foraging areas. Audible mastiff bat echolocation calls and feeding buzzes were also heard in a few locations within these high elevation meadows. Over 12 weeks spanning three summers, we caught 24 spotted bats and 17 mastiff bats in 41 nights of netting and heard many spotted bat and mastiff bat calls. We caught other bats with audible echolocation calls that also used the meadows for foraging (big free-tail, *Nyctinomops macrotis*; Mexican free-tail, *Tadarida brasiliensis*; and Allens big-eared bat, *Idionycteris phyllotis*), but spotted bat and mastiff bat calls are distinctive (Fenton et al., 1987; Cockrum, 1960) and we could distinguish their calls from the others. Although we netted ponds within forested habitat on the NKR D, we rarely heard and never caught spotted or mastiff bats in forested areas.

Throughout the 1997 survey, fourteen nights of trapping resulted in the capture of 352 bats representing 14 species including 10 spotted bats and three mastiff bats (Table 1, see Appendix 1 for details). Radio transmitters were placed on seven spotted bats and one western mastiff bat (Table 2). All of the spotted bats were lactating females, the western mastiff bat was a non-lactating female.

Spotted Bat

Spotted bats are rapid flyers (Woodsworth et al. 1981; Wai-Ping and Fenton, 1989) and rugged topography and few roads on the NKR D made nighttime pursuit difficult. While radio tracking from the ground, foraging bats were rarely detectable >1.5 km due to effects of forest canopy and topography. When in open country or from lookout towers, we were sometimes able to detect the bats from a greater distance. Initial attempts to detect signals from roosting bats during daylight, even from aircraft, were unsuccessful. However, by using a combination of vehicle pursuit and hilltop radiotelemetry sites at night, several bats were relocated sufficiently to obtain general flight directions during early morning when bats left meadows and were presumably en route to day roosts. As the direction of the bats' travel to its roost was determined, people were stationed farther and farther in that direction. Eventually, people were stationed at four points on the southwestern edge of the Kaibab Plateau overlooking the Grand Canyon to the south and Kanab Creek to the west. Six of the seven bats flew near the confluence of the Colorado River and Kanab Creek.

In July 1997, we tracked 4 lactating females to a day roosts in remote areas of Grand Canyon National Park (GCNP) and Kanab Creek Wilderness on the NKR D (Table 2, Fig. 3). Distances from the capture sites ranged from ca. 38 km to 43 km. We located the roosts from airplane overflights after triangulating transmitter signals from the canyon rims in early morning. The maternity roosts ranged in elevation from ca. 700 m to 1080 m. The one maternity roost found near the Colorado River was approximately 850 m from the river. The three maternity roosts located within the Kanab Creek canyon were all <100m from Kanab Creek. Roost sites were located in Sonoran Desert habitat with predominantly catclaw (*Acacia greggii*) and mesquite (*Prosopis glandulosa*) vegetation (Appendix 2). Because these roosts were located in very rugged, isolated desert country, only one of the roosts (Bat 150.275) was possible to visit for an exit count and habitat measurements (Table 4). This maternity roost located within the Kanab Creek wilderness was visited on two occasions to identify the exact location of the

roost on July 18 and July 24. The exact crack could not be determined during exit counts, however the general location was in a cliff face, approximately 20m from the base of the cliff, which was the top one-third of the cliff. A single bat was heard exiting and returning, however no bats were visually observed at this crack. She exited her roost at approximately 2015 (ca. 30 min after sunset) each night and returned to her roost at approximately 0420.

Similar to the spotted bats radio tracked in 1996 (Rabe et al. in press), the bats in 1997 again followed a predictable patterns in their foraging movements. The spotted bats were monitored throughout the night during foraging and then followed to their roosts as they returned in the morning. Radio-tracking throughout foraging areas was done mainly from four points encompassed by the meadow systems in which the bats had been captured. Female spotted bats spent approximately three hours foraging in the high elevation meadows. With extensive radio telemetry on six lactating female spotted bats in 1997, there appeared to be overlap of foraging territories (Fig. 4). The bats covered large areas throughout their nighttime movements (Table 5). They traversed up to eleven linear miles during foraging. They spent most of the night moving throughout several meadow systems. The meadows were located in the bottom of drainages and were bordered by forested slopes of gentle to moderate steepness. In 1997, we again noticed night roosting behavior in some of the females, however they also appeared to arrive in the meadow systems later and leave earlier than in 1996. Since we were tracking spotted bats slightly earlier in the season from 1996, it was thought that perhaps the females could not leave younger offspring for long periods of time due to feeding demands. They would arrive in the meadow systems at approximately 2300 and leave at approximately 0200. Again they did not seem to forage on their way back to their canyon day roosts, but flew rapidly southwest (ca. 50 km/hr) to the general area of Fishtail Mesa in the Grand Canyon, then on to their roosts either along the Colorado River or up Kanab Creek drainage (Fig. 5).

Greater Western Mastiff Bat

In 1997 we captured several mastiffs at new locations in higher elevation meadow tanks (Fig. 6), however since we assumed that the 1995 trap location was near the maternity roost, we waited to attach radios until we returned to that trap location. Although many were heard at the trap site (2100m elevation) at various times during the summer, we were only able to capture one non-reproductive female. We held her until early morning (ca. 0400) when a plane was ready to follow her home. Due to technical difficulties in communication between the ground and the airplane, we did not release her as early as planned. The plane was able to track her until just after sunrise, when she roosted in a tall ponderosa pine tree near the rim of the Grand Canyon, ca. 19.5 km from the trap site (Fig. 7). Over six nights of telemetry from stationary points along the rim, we were able to triangulate on a general roost location (20 km² area) along the Colorado River (ca. 29 km from the trap site) where the bat appeared at ca. 2000 and disappeared at ca. 0500 each day (Fig. 6). On day six, two individuals hiked down into the canyon to try to get a better fix on the location from within the canyon, as well as individuals at three locations on the rim. No signal was detected that night and it was assumed that she dropped her transmitter at the roost. A plane made an overflight of the area two days later, but was unsuccessful as well.

Although we did not attempt to determine the foraging areas for the mastiff, she did return to the plateau and headed in the general direction of the trap site each night. Mastiff bats were also heard in several locations on the plateau in meadows, and they appeared to travel in groups. A pond would be silent, then suddenly calls of several mastiff bats would be heard working the area for a time, then they would

leave. It has been suggested that these bats forage in groups, keeping contact with their roost mates (Hoffmeister, 1986).

DISCUSSION

Female spotted and mastiff bats appear to forage long distances from their night roosts and utilize completely different habitats for roosting and foraging habitats. The differences between the foraging behaviors of spotted bats in British Columbia and the Kaibab Plateau may be explained by a lack of suitable high-cliff roost sites near the meadow systems on the Kaibab Plateau. In British Columbia, observed spotted bats foraged in open areas 6 to 10 km from day roosts in cliffs, foraged continuously while away from cliff roosts, and flew at about 19 km/h while foraging (Wai-Ping and Fenton, 1989). The night-roosting we observed may be a response to the high energetic demand of long distance flight and lactation. The faster flight speeds we report probably indicate that bats on the Kaibab Plateau were not foraging on their return flight and may approximate the actual flight speed capabilities of spotted bats.

The long distance traveled by these spotted bats from roost to foraging habitat (77 - 86 km round trip) is substantially longer than previously reported distances for this species (Wai-Ping and Fenton, 1989), and makes us question why a lactating bat would travel so far to forage. Spotted bats have very low frequency echolocation calls that may enable them to detect insects at relatively long distances but probably limits them to resolving large (>10 mm) prey (Woodsworth et al., 1981; Leonard and Fenton, 1984). Spotted bats may therefore prefer open foraging areas because uncluttered habitats allow detection of large prey items at relatively long distances.

Little has been described about the foraging habitat and habits of mastiff bats. Due to the timing of our first and last radio signals each day, we feel confident that this bat was roosting near the Colorado River in the Grand Canyon. The long distance traveled by this mastiff bat from roost to trap site (58 km round trip) also makes us question why this bat would travel so far to forage. Mastiff bats are known to require larger, more open waters from which to drink (Hoffmeister, 1986) so perhaps the Colorado River is too turbulent a water source for them to utilize. In which case, those waters where we have observed mastiff bats may be extremely important to this species.

For both the spotted and mastiff bats to travel such distances for foraging, we suspect there may be an abundance of insect prey in the high meadow systems sufficiently valuable to justify the energy expenditure of such long flight distances. The large elevational and temperature differences between the low, hot desert cliff roost in GCNP and high, cool subalpine meadows on the NKRD present an opportunity to forage in several habitat types, but high energetic demands of lactation (Racey, 1982) should force lactating females to choose the most productive foraging habitat. Although we have not yet analyzed insect sampling data, large moths appeared abundant in meadows on the NKRD during July and August. Further research should document whether the long day-roost to foraging distance and night roosting behavior of these bats is typical of local spotted and mastiff bats and what insect species bats select in these meadows.

From the results of this work, as well as previous years work on spotted bats, and the work on spotted bats in the Arizona Strip and Southern Utah by Michael Herder, we will be producing a joint manuscript analyzing spotted bat habitat use in the Arizona Strip and Southern Utah area. We had limited success with the mastiff bats this season and would like to attempt to locate a maternity roost as well as

characterize the foraging habitat of the mastiff bats. We are currently searching for additional funding
continue the work on mastiff bats.

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