Final Report to the Lois Webster Fund of the Audubon Society of Greater Denver

Project Title:
Ecological characteristics of bats in Mesa Verde National Park, Colorado

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Please note: the main additions since the July 2008 interim report are in the roosting ecology section.

Background and Introduction

Mesa Verde National Park has documented the bat species that occur on its lands, but the ecology and status of these animals remain unknown (O'Shea and Bogan 2000). Over 15,000 ha of the park, totaling more than 70% of the park's area, have burned since 1996, and the piñon-juniper woodlands are not regenerating (Romme et al. 2003). The park is at a crossroads in determining how to effectively manage the remaining forest for natural and cultural resources, while preventing future fires from destroying more habitat. Within the park, little is known about the insect prey of these bats, and in particular the effects of wildfire and potential fire prevention management activities on this vital resource. The uniqueness and rarity of the old-growth piñon-juniper woodlands of Mesa Verde warrant an examination of its bat community to ensure sound management. I am studying the habitat ecology of Mesa Verde bats by investigating roosting ecology, food habits and insect prey availability. Results from this study will provide bat and fire ecologists, as well as resource managers, with some of the first ecological information about the Western long-eared bat's (*Myotis evotis)* roosting ecology in Colorado, the food habits of three closely related species of the genus *Myotis* in old-growth piñon-juniper woodlands, insect prey dynamics, and the relationship of these characteristics with stand-replacing wildfire.

Project summary

The field seasons ran from May-August 2006 and 2007. I followed standard procedures for capturing, handling and releasing bats. I captured 2,002 bats of 15 species (Table 1), including two species new to the park—Spotted bat (*Euderma maculatum*) and Yuma Myotis (*Myotis yumanensis*).

Roosting ecology

I marked a sample of the reproductive female long-eared bats ($n = 25$) with radiotransmitters weighing up to about 5% of their body weight, and tracked them to their day roosts ($n = 41$) using standard telemetry procedures. Most of the roosts ($n = 35$) were located in cliffs and rock crevices (Figure 1). The remaining roosts ($n = 6$) were in piñon

study species. However, the other explanations may apply to long-eared bats at Mesa Verde. The park is home to a number of potential predators of bats including snakes, ringtails, bobcats and foxes. While an abundance of rock crevices are available at ground level on rocky, talus slopes and beneath boulders, if bats roosted in these locations, they may have an increased chance of encountering a predator. As bats fly, they may be more likely to detect and investigate crevices at their flight level, rather than areas close to the ground. Bats chose crevices that were deeper than unoccupied crevices. A deeper crevice may allow the bat to behaviorally modify its microclimate. During the day, a heat gradient can develop with the warmest area being near the entrance and the coolest area being in the back of the crevice. At night, the entrance will lose heat more rapidly than the back portions of the crevice, so pups may move to the back of the crevice to maintain their body temperatures while the adult is out foraging. I presented these results at The Wildlife Society annual conference in Miami, Florida in November.

Insect communities

Insect samples were collected from different forest strata at paired burned and unburned sites where the long-eared bat, *M. thysanodes*, the fringed bat, and *M. volans,* the long-legged bat, were likely to forage. I used multiple insect sampling methods—light traps, beating, and sweepnetting—to decrease the bias inherent in any one method. Sample collection occurred every two weeks from May-August 2006 & 2007 to detect changes in insect diversity and abundance during the season and to determine whether these changes are reflected in the bats' diets. Insects were identified to the family level in the lab, using a dissecting scope, taxonomic keys (Triplehorn et al. 2005), and a list of insects previously documented at the park (Kondratieff 2000).

With the assistance of work-study students, I identified approximately 60,000 insects (half positively identified, half identified by subsampling) (Figure 2) belonging to 19 orders and 159 families, and added 2 orders and 47 families to the park's previously documented insect fauna. Burned sites had lower total insect numbers and species richness, but higher evenness and diversity, as measured by Simpson's Index, than unburned sites. More than twice as many insects were captured in unburned (44,233) than in burned (20,385) sites, and the proportions by habitat were similar in both years. But while the proportions were similar, the numbers were very different—approximately 1.6 times as many insects were collected in 2007 than in 2006.

Mesa Verde received almost three times as much rain during the summer of 2007 than the summer of 2006, and vegetation was more lush and abundant in 2007. This increase in vegetation may have provided more locations for insects to forage, hide from enemies, and oviposit than in 2006. In 2006, the year I captured fewer insects, 30% of adult female bats of six species of the genus *Myotis* captured in the park showed signs of reproduction, and the same value, 30%, of long-eared bats were reproductive. In 2007, when insect captures were higher, 68% of adult female bats of six species of the genus *Myotis* were reproductive, including 69% of the long-eared bats. Of course I can't claim a direct cause and effect relationship, but I can say that there is evidence that insect abundance may have cascading effects up the food chain and affect bat reproduction at Mesa Verde. Moths and beetles are the most common insect prey of species of the genus

maneuverable species and prefers to drink over small open water sources—the types of water sources that have been lost since Mesa Verde's large fires. It may be that I wasn't catching these bats simply because I wasn't at their preferred water sources, or it could be that because their preferred sources are greatly diminished, this species is present in lower numbers than in the past.

Now back to the focal species, the long-eared bat. My study highlights the importance of site-specific examinations of roosting behavior in bats because differences exist between geographic regions, even among areas with similar vegetative communities. As far as roosting habitat for this species, it appears that tree roosts are not a vital resource when rock roosts are available. But nevertheless, the piñon-juniper woodlands are likely important in providing foraging opportunities. I want to re-emphasize the uniqueness and rarity of Mesa Verde's old-growth piñon-juniper. The remaining mature woodlands are an important habitat for insects in the park and should be valued for their plant and insect biodiversity, and their potential to provide a food source for bats and other insectivores.

Thank you!

Thank you very much for supporting my research through the Lois Webster Fund. I think my project has supported the mission of the Audubon Society in three ways—by initiating research that I hope will help us to conserve bats and their habitat, by informally educating hundreds of park visitors about bats in the park and their importance to ecosystems, and by helping train young scientists with interns during the summer and students in work-study positions during the academic year.

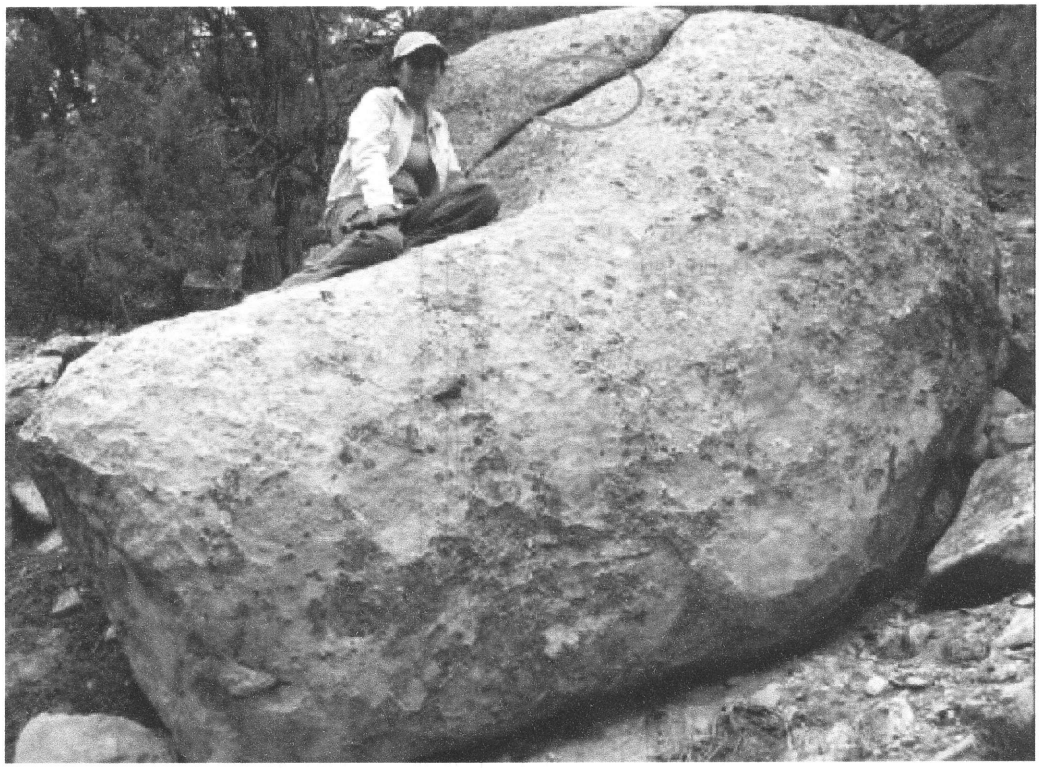

Figure 1. Examples of rock crevice roosts used by long-eared bats.

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