1996

# Observations on Bats at Badlands National Park, South Dakota

Michael A. Bogan
*University of New Mexico*

Jeffrey G. Osborne
*University of Northern Colorado*

Jennifer A. Clarke
*University of Northern Colorado*, jclarke@unity.edu

# Observations on Bats at Badlands National Park, South Dakota

MICHAEL A. BOGAN, JEFFREY G. OSBORNE[1] and JENNIFER A. CLARKE

U. S. Geological Survey, Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM 87131 (MAB); Department of Biological Sciences, University of Northern Colorado, Greeley, CO 80639 (JGO, JAC)

**ABSTRACT**– During the summers of 1992 and 1993, we conducted a survey of bats at Badlands National Park, South Dakota. Using mist nets, we captured bats and recorded species, sex, age class, and reproductive condition for each individual netted. We recorded five species, *Myotis ciliolabrum* (n = 198), *M. thysanodes* (29), *M. volans* (13), *Eptesicus fuscus* (91), and *Plecotus townsendii* (43), previously known from the park. In addition, we added four species, *M. lucifugus* (18), *M. septentrionalis* (9), *Lasionycteris noctivagans* (1), and *Lasiurus cinereus* (3) to the confirmed fauna of the park. Most bats captured were male (76.3%) although maternity colonies of at least *M. volans* and *P. townsendii* likely exist in the park. Reproductive activity was observed for all species except *L. noctivagans* and *L. cinereus*, which probably just migrate through the area. In addition to crevices, bats used caves as summer roosts. The availability of roosts, coupled with the presence of nearby foraging areas and water sources, makes Badlands National Park an important summer habitat and likely migration stopover for bats.

**Key words:** Chiroptera, bats, roosts, Badlands National Park, South Dakota.

Much remains to be learned about the natural history of bats in South Dakota and of possible threats to their continued existence. Of the 11 species of bats known from South Dakota, all are insectivorous, three are thought to migrate south in the winter, and eight species likely hibernate in winter roosts near their summering grounds (Choate and Jones 1981, Jones et al. 1983). Most published information on bats in South Dakota is from the more topographically varied western part of the state, especially the Black Hills and Badlands (Choate and Jones 1981).

Bat populations are thought to be strongly influenced by the presence of secure roosting sites (Humphrey 1975). In general, bats need roosts for protection from the elements and predators, for resting between nocturnal

[1] Present address of Osborne: Department of Biology, Northern Arizona University, Flagstaff, AZ 86011

foraging bouts, for raising young, and for hibernating in winter. Exact characteristics of preferred sites vary and for many bats our understanding of their specific roosting needs is quite imperfect. The Badlands of South Dakota appear to provide suitable habitat and an abundance of potential roost sites for bats (Tuttle and Heaney 1974). Five species have been reported for this area: *Myotis ciliolabrum, M. thysanodes, M. volans, Eptesicus fuscus*, and *Plecotus townsendii* (Farney and Jones 1980). All of these except *E. fuscus* are species of concern (U.S. Fish and Wildlife Service 1994, 1996). Thus, our goals in studying bats at Badlands National Park were to: 1) assess species composition, distribution, and relative abundance of bats; 2) compare relative bat activity in different habitats and areas; and 3) locate roost sites where possible.

## METHODS

We studied bats at Badlands National Park for portions of two summers: 25 June to 15 August 1992 and 20 May to 19 August 1993. We selected sites that looked favorable for capturing bats, such as water sources, flyways, and near potential roosts. Most sites that we netted were in the eastern part of the park, although we netted elsewhere. At each site we set three to six mist nets (6, 10, and 14 m in length), opened nets just before sunset and tended them until activity diminished; only rarely were nets left up all night. We spent approximately 60 nights netting or listening to bats with a narrow-band ultrasonic detector (Skye-Probetech Model 1200). We used the detector to determine if bat activity was present at given sites, not to identify bats. We sampled each site about every 10 days to avoid undue disturbance and to prevent diminished capture success (Kunz and Kurta 1988).

We identified each captured bat and also recorded sex, age, and reproductive condition. We released bats unharmed after examination. In connection with other work, we marked eight *P. townsendii* with bands provided by the U. S. Forest Service. We retained one or two vouchers of each species and deposited them in the vertebrate collection at Badlands National Park or in the Biological Surveys Collection (BS/FC), which was recently moved to Albuquerque, New Mexico. We determined sex by examination of primary sexual characteristics and age by the degree of fusion of the phalangeal epiphyses (Anthony 1988). Lactating females were characterized by swollen mammary glands, presence of milk, or absence of hair around the nipples; we determined pregnancy by palpation. We examined males to determine if the reproductive glands (testes, epididymides, or caudae) were enlarged; enlargement is indicative of spermatogenesis (Racey 1988).

We searched for day roosts in crevices and caves formed by erosion of the badlands formations. Outcrops of this formation are more common in the

eastern part of the park and that is where we spent the most time searching. We looked and listened for bats and searched for guano. The majority of crevices and caves could not be entered safely due to the friable nature of the substrate; in some instances we positioned ourselves outside a likely roost prior to sunset and watched for exiting bats.

## RESULTS AND DISCUSSION

During our study, we captured 405 individual bats at nine sites (Table 1), which included five species previously known from the park (Farney and Jones 1980). We also captured four species not previously recorded from the park: *M. lucifugus, M. septentrionalis, Lasionycteris noctivagans,* and *Lasiurus cinereus.* B. Bessken (pers. commun.) reported that pellets, likely from a long-eared owl (*Asio otus*) and collected in the park in September 1993, contained the skull of one *L. cinereus.* We captured *M. ciliolabrum* (n = 198) most frequently, followed by *E. fuscus* (91), *P. townsendii* (43), *M. thysanodes* (29), and *M. lucifugus* (18; Table 1). The rank order of species captured by Farney and Jones (1980) is different: *M. ciliolabrum* ("several hundred"), *M. volans* (50), *E. fuscus* (29), *M. thysanodes* (10), and *P. townsendii* (5). We captured surprisingly fewer *M. volans* and notably more *M. thysanodes, E. fuscus,* and *P. townsendii.* However, exact comparisons between our study and that of Farney and Jones (1980) cannot be made because of differences in sites netted, water availability between years, and level of effort expended. Farney and Jones (1980) banded some bats; we did not capture any banded bats.

Of 405 bats captured, 390 were taken at three eastern locations (Norbeck Pond, 183; Cliff Shelf West, 113; Cliff Shelf, 68) and one western locality (Close Spring, 26). Farney and Jones (1980) netted only at Cliff Shelf and Close Spring, which are described in their paper. Norbeck Pond (0.5 km E Norbeck Pass) is in one of two small groves of cottonwoods (*Populus* sp.) that are apparently nourished by occasional pools of water that form there. Cliff Shelf West is located west across Route 240 from the Cliff Shelf Nature Trail. Norbeck Pond and the Cliff Shelf localities are characterized by their proximity to broken and eroded badlands formations and the presence of mature cottonwood and cedar (*Juniperus* sp.). We observed bats foraging for insects around these trees. The presence of water at these sites appears to be ephemeral. Close Spring is 10-12 km from typical badlands habitat and its attractive feature to bats is that it appears to provide permanent water. Netting at other sites in the park that lacked trees, rock formations, or water sources generally was unproductive, with only 0-2 bats captured per night. Some of these sites had water, and we noted the presence of bats with the ultrasonic detector.

**Table 1.** Captures of bats at Badlands National Park, South Dakota, 1992-1993. Common and scientific names follow Jones et al. (1992).

| Species | Males | Females | Total |
|---|---|---|---|
| *Myotis ciliolabrum* (western small-footed bat) | 171 | 27 | 198 |
| *M. lucifugus* (little brown myotis) | 15 | 3 | 18 |
| *M. septentrionalis* (northern myotis) | 8 | 1 | 9 |
| *M. thysanodes* (fringed myotis) | 24 | 5 | 29 |
| *M. volans* (long-legged myotis) | 4 | 9 | 13 |
| *Lasionycteris noctivagans* (silver-haired bat) | 0 | 1 | 1 |
| *Eptesicus fuscus* (big brown bat) | 81 | 10 | 91 |
| *Lasiurus cinereus* (hoary bat) | 0 | 3 | 3 |
| *Plecotus townsendii* (Townsend's big-eared bat) | 6 | 37 | 43 |
| TOTAL | 309 | 96 | 405 |

Farney and Jones (1980) noted that most of the species they captured have western affinities, except for *E. fuscus pallidus*, which they characterized as widespread in distribution. *Eptesicus fuscus pallidus* is the Rocky Mountain race of the big brown bat. The four species previously unknown from Badlands National Park include two widespread species, *L. cinereus* and *L. noctivagans*, both presumed tree-roosting migrants, and a species with more eastern affinities, *M. septentrionalis*, although this species is known from the Black Hills (Turner 1974). Our records of *M. lucifugus* are from the hiatus between the eastern subspecies *lucifugus* and the western race, *carissima* (Hall 1981). We tentatively assign our single specimen to *M. l. carissima* on the basis of fur color and skull morphology. Although *M. thysanodes* was once

thought to be restricted in South Dakota to the Black Hills, from where the subspecies *pahasapensis* was named (Jones and Genoways 1967), the species is now known regionally from western Nebraska (Czaplewski et al. 1979), southeastern Wyoming (Boyce 1980, Clark and Stromberg 1987), and perhaps northeastern Colorado (Bogan, unpubl. data). Of the nine species now known from Badlands National Park, we believe six have western affinities at the specific or subspecific level, two (*L. cinereus* and *L. noctivagans*) are widespread, and one (*M. septentrionalis*) has eastern affinities. We did not capture *M. evotis*, which has an intriguingly restricted distribution in western South Dakota, nor *L. borealis*, which is known from scattered localities statewide (Choate and Jones 1981).

Males dominated our samples of five species and represented 76.3% of all bats captured. Farney and Jones (1980) also found males to be more common than females among their samples of *M. ciliolabrum*, *M. thysanodes*, and *E. fuscus*. We did capture more female than male *M. volans* (69%) and *P. townsendii* (86%). Two of our netting sites may have been near maternity colonies. Adult female *M. volans* were slightly more common than adult males at Norbeck Pond and 93% (28/30) of adult female *P. townsendii* were captured near Cliff Shelf. We captured only female *L. noctivagans* and *L. cinereus*, a pattern more typical of the eastern United States. All three *L. cinereus* were taken in mid-August and the only *L. noctivagans* was captured in late May; both dates suggest that these species were migrating through the area.

Pregnant females of *M. ciliolabrum* (n = 1), *E. fuscus* (3), and *P. townsendii* (3) were captured (Table 2). Both voucher specimens of *P. townsendii* contained a single fetus. We captured lactating females of all species except for *E. fuscus* and *L. noctivagans*. Female *L. cinereus* were postlactating when captured. Starting in late July, our samples contained volant young-of-the-year of *M. ciliolabrum*, *M. volans*, *M. septentrionalis*, *M. thysanodes*, *E. fuscus*, and *P. townsendii*. Males with enlarged reproductive glands were first captured in early August. The proportion of such males increased until netting was concluded each year. In general, our observations on reproduction are in accord with those of Tuttle and Heaney (1974) and Farney and Jones (1980) and suggest that most summer-resident bats reproduce in Badlands National Park or nearby.

**Table 2.** Age and reproductive condition of bats at Badlands National Park, South Dakota, 1992-1993. Numbers are individuals captured in each category.

| Species | Juveniles | Lactating | Pregnant | Males[1] |
|---|---|---|---|---|
| *Myotis ciliolabrum* | 13 | 6 | 1 | 13 |
| *M. lucifugus* | 0 | 1 | 0 | 4 |
| *M. septentrionalis* | 1 | 1 | 0 | 1 |
| *M. thysanodes* | 1 | 2 | 0 | 3 |
| *M. volans* | 2 | 5 | 0 | 0 |
| *Lasionycteris noctivagans* | 0 | 0 | 0 | 0 |
| *Eptesicus fuscus* | 3 | 0 | 3 | 21 |
| *Lasiurus cinereus* | 0 | 3 | 0 | 0 |
| *Plecotus townsendii* | 7 | 9 | 3 | 3 |

[1] Presumed reproductively-active males based on presence of enlarged testes, epididymides, or caudae.

We found bat guano at 24 small crevices in canyon walls in Badlands National Park. We think bats were using these areas as summer night roosts. Tuttle and Heaney (1974) found 12 active summer day roosts containing 27 *M. ciliolabrum* in and near the park. Most roosts contained solitary individuals or a female with young. Tuttle and Heaney (1974) postulated that *M. ciliolabrum* exercises considerable selectivity in choice of roost sites; active roosts tended to be small, dry, shallow, and of uniform high temperature (average 29° C). In addition to the crevices with bat guano, we found five small caves that showed signs of use and we observed bats exiting each of these caves. We netted *M. lucifugus* (n = 1) and *M. ciliolabrum* (5) at the cave near Door Trailhead. The caves seemed subjectively cooler in temperature than crevice roosts and we found no maternity roosts in any of the caves.

Males and females likely choose different types of summer roost sites in the park, probably for thermoregulatory reasons. Male bats may enter daily torpor as a means of energy conservation and thus are able to occupy areas with cool day roosts, whereas reproductive female bats must maintain a higher metabolism during gestation and lactation and require relatively warmer roosts (Kunz and Nagy 1988). In the eastern portion of the park, near areas with cliffs and potential cave roosts, only 18% (64/346) of the adult bats captured were female. In the western portion of the park, which is far from potential cave roosts, but has more trees, 50% (16/32) were female. More data are needed to ascertain the extent to which the two sexes are segregating in choice of either roosting or foraging sites.

On 21 January 1994, J. Tigner and B. Bessken (pers. commun.) found a solitary torpid *P. townsendii* in a cave near Norbeck Pass. At the same time, three other caves (Canyon Climb, Saddle Pass, and near Pinnacles Grade) were searched, but yielded no hibernating bats.

Badlands National Park clearly provides important habitat for a diverse and dynamic bat community, including four species of concern (U.S. Fish and Wildlife Service 1994, 1996). In the park, varied roosts are available near bodies of water and foraging sites, all of which are necessary for summer-resident females to successfully breed and raise young. Additionally, Badlands National Park may provide an essential "island stopover" for migrating species such as *L. cinereus* and *L. noctivagans*. At least one additional species, *L. borealis*, will likely be found in the park. Additional data on population trends of bats at Badlands National Park are desirable, and this might be done by periodic monitoring of the more productive sites that we netted. Likewise, data are needed on species-specific habitat use, both for roosting and foraging.

## ACKNOWLEDGMENTS

Our work was conducted as part of an Interagency Agreement (NPS IA-1200-9-0002) between U. S. Fish and Wildlife Service (USFWS) and National Park Service (NPS); both agencies contributed resources toward the study. We thank Robert Schiller of NPS for his advice and support. We appreciate the help of Bruce Bessken, Valerie Naylor, Bethany Hartford, and other members of the Badlands National Park staff, as well as Steve Mackessy of University of Northern Colorado, and Mylea Petersburg, Cindy Ramotnik, Mike Shipman, Ernie Valdez, and especially David Worthington of the Midcontinent Ecological Science Center (then USFWS, now U. S. Geological Survey). Joel Tigner of the U. S. Forest Service in Deadwood provided bands for *P. townsendii* and assisted in the field.

## LITERATURE CITED

Anthony, E. L. P. 1988. Age determination in bats. Pp. 47-58 *in* Ecological and behavioral methods for the study of bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, DC.

Boyce, M. S. 1980. First record of the fringe-tailed bat, *Myotis thysanodes*, from southeastern Wyoming. Southwestern Nat. 25:114-115.

Choate, J. R., and J. K. Jones, Jr. 1981. Provisional checklist of mammals of South Dakota. Prairie Nat. 13:65-77.

Clark, T. W., and M. R. Stromberg. 1987. Mammals in Wyoming. University of Kansas, Museum of Natural History, Public Ed. Series 10:1-314.

Czaplewski, N. J., J. P. Farney, J. K. Jones, Jr., and J. D. Druecker. 1979. Synopsis of bats of Nebraska. Occasional Papers Museum, Texas Tech Univ. 61:1-24.

Farney, J. P., and J. K. Jones, Jr. 1980. Notes on the natural history of bats from Badlands National Monument, South Dakota. Prairie Nat. 12:9-12.

Hall, E. R. 1981. The mammals of North America. Wiley and Sons, New York, Second Ed., I:1-600.

Humphrey, S. R. 1975. Nursery roosts and community diversity of Nearctic bats. J. Mammal. 56:321-346.

Jones, J. K., Jr., and H. H. Genoways. 1967. A new subspecies of the fringe-tailed bat, *Myotis thysanodes*, from the Black Hills of South Dakota and Wyoming. J. Mammal. 48:231-235.

Jones, J. K., Jr., D. M. Armstrong, R. S. Hoffman, and C. Jones. 1983. Mammals of the northern Great Plains. University of Nebraska Press, Lincoln.

Jones, J. K., Jr., R. S. Hoffmann, D. W. Rice, C. Jones, R. J. Baker, and M. D. Engstrom. 1992. Revised checklist of North American mammals north of Mexico, 1991. Occasional Papers Museum, Texas Tech Univ. 146:1-23.

Kunz, T. H., and A. Kurta. 1988. Capture methods and holding devices. Pp. 1-29 *in* Ecological and behavioral methods for the study of bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, DC.

Kunz, T. H., and K. A. Nagy. 1988. Energy budget analysis. Pp. 292-295 *in* Ecological and behavioral methods for the study of bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, DC.

Racey, P. A. 1988. Reproductive assessment in bats. Pp. 31-45 *in* Ecological and behavioral methods for the study of bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, DC.

Turner, R. W. 1974. Mammals of the Black Hills of South Dakota and Wyoming. Miscellaneous Publ., Mus. Nat. History, University of Kansas 60:1-178.

Tuttle, M. D., and L. R. Heaney. 1974. Maternity habits of *Myotis leibii* in South Dakota. Bull. Southern California Acad. Sci. 73:80-83.

U. S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species; proposed rule. Federal Register 59(219): 58982-59028.

U. S. Fish and Wildlife Service. 1996. Endangered and threatened species; plant and animal taxa; proposed rule. Federal Register 61(40): 7596-7613.

*Received:* 10/31/95 *Accepted:* 5/29/97