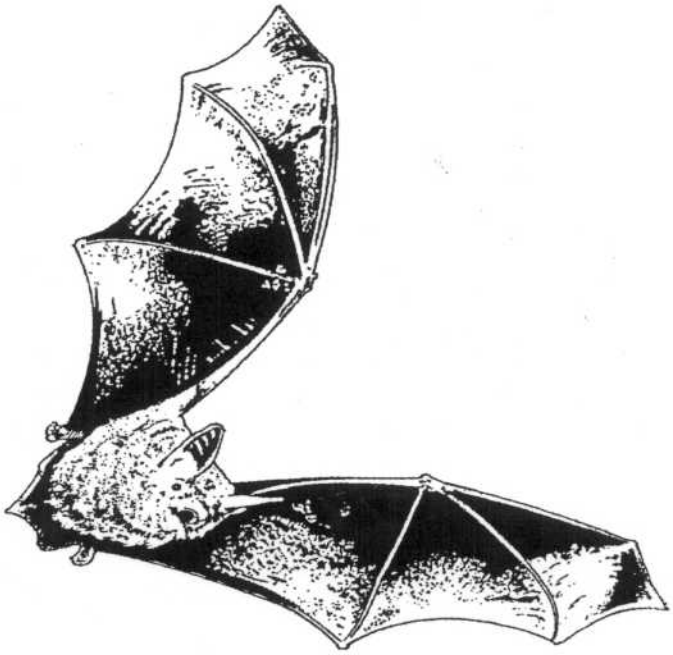
South Dakota Bat Management Plan



South Dakota Bat Working Group
Wildlife Division Report 2004-08
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Signature Page

Protecting wildlife diversity in South Dakota is important to conservationists alike thus we the undersigned vow to work tow and protecting bat fauna throughout the state by implementing action items (e.g., strategies) in this plan.

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Preface

Twelve bat species can be found throughout South Dakota comprising approximately 12 percent of the state's mammal fauna. As efficient predators of night-flying insects, bats are integral components of the environment and provide a substantial economical service as they feed on agricultural and forest insect pests.

Bat populations depend largely on their ability to find safe, secure roosting habitat. Unfortunately, this habitat is in jeopardy in many areas. Depending on the species of bat, bats may roost in a wide variety of sites from rock crevices and cavities (caves, abandoned mines) to trees, both living and dead (snags), and structures such as buildings, bridges and even the artificial `bat houses' that are becoming somewhat popular. It is important to note that due to micro-site (temperature) conditions and other selection criteria that are not fully understood, bats can be very selective regarding roost sites.

Besides roosting habitats, bat foraging habitat is also being degraded or destroyed, which reduces the availability of insect prey and drinking water. As well, other factors such as lack of protective regulations and a general public image of being rabid and dangerous pose threats to bats.

Therefore, an increased effort to protect, conserve and manage bats and their habitats in South Dakota is required. The *South Dakota Bat Management Plan* (SDBMP) is designed to identify risks to bats, develop objectives and strategies to conserve bats and to educate people about them, and make management recommendations associated with protecting bats and their habitats in South Dakota.

All future bat conservation efforts in South Dakota will depend on cooperation among agencies, groups, organizations, and individuals in order to achieve these objectives and strategies.

The South Dakota Bat Working Group initiated the development of this management plan and formed the framework through meetings and group discussions. Sixteen agencies, organizations, and individuals were involved with developing the South Dakota Bat Management Plan. These and other agencies, individuals, and organizations will be the cooperators in this effort. Bat conservation has become an important wildlife management goal as agencies, organizations, and individuals recognize the ecological and economic value of bats. This State Management Plan is the first step. As time progresses, and we grow in our understanding of bats and their habitat needs the South Dakota Bat Working Group will utilize a pro-active approach to managing wildlife - *adaptive management* - to improve this plan.

Acknowledgements

The South Dakota Bat Working Group would like to acknowledge the efforts of individuals in the development of this plan. Working Group members include researchers, biologists, educators, and managers from different areas of the state. South Dakota Game, Fish and Parks personnel were particularly dedicated to the formulation and writing of the plan. People involved with the development of this plan include: Alyssa Kiesow, Barb Muenchau, Brad Phillips, Chad Tussing, Cheryl Schmidt, Doug Backlund, Eileen Dowd-Stukel, Joel Tigner, Lon Kightlinger/Linda Schaefer, Natalie Gates, Sara Reindl, Scott Pedersen, Stephanie Middlebrooks, and Vicki Swier.

Also, many individuals of state, federal, and other organizations reviewed drafts of this plan throughout its development and/pr provided their expertise in various areas covered in the plan. Those individuals include Barb Muenchau, Brad Phillips, Brian Scott, Cheryl Schmidt, Connie Vicuna, Dan McCormick, Dan Foster, Doug Backlund, Doug Hansen, Eddie Childers, Eileen Dowd Stukel, George Vandel, Karen Hall, Heather Johnson, Joan Bortnem, Joel Tigner, Kim Schultz, Lon Kightlinger, Marc Ohms, Paige Hoskinson, Renee Ohms, Rodd Horricks, Scott Pedersen, Shelly Diesch, Stan Michals, Steve Hirtzel, Steve Wilson, and Vicki Swier.

Executive Summary

Bat populations are declining locally, and continentally, due to habitat loss and fragmentation, roost disturbances, public lack of awareness, and poor regulatory measures. The South Dakota Bat Working Group and South Dakota Game, Fish and Parks recognize the ecological and economic benefits of bats and are initiating efforts to protect habitats and conserve bats in South Dakota. This South Dakota Bat Working Group seeks to protect bats and bat habitat through action, education, and cooperation with federal, state, and private landowners. Objectives include raising awareness concerning the role bats play in maintaining healthy ecosystems and working with public land managers and private landowners to reduce possible disruptions to bats and their habitat. South Dakota Game, Fish and Parks, specifically the Wildlife Diversity Program, seeks to inventory, protect, and manage species and habitats in a manner that meets the needs and desires of the people of the state while protecting South Dakota's biological diversity. Efforts towards conserving bats and their habitats in South Dakota include the development and implementation of a state bat management plan.

The South Dakota Bat Management Plan includes general background information, a management plan outline, and numerous appendices. General background information includes details concerning bats and their habitat, health issues, management justification, and bats' legal status. The management plan outlines objectives,. strategies, and makes management recommendations by taxon or habitat of bat species in the management, research, and education sections. Numerous appendices include species accounts, written articles regarding bats, and current federal laws associated with bats and their habitat.

The main goal of the South Dakota Bat Management Plan is to provide guidance promoting long-term conservation of South Dakota bat species through research, management, and education. Through the implementation of this plan, bat conservation efforts will be strengthened and cooperation among agencies, organizations, and landowners, as well as regulatory measures, will be enhanced. The goal is a reversal of downward trends of particular bat populations noted in bat survey work conducted through the years.

Bats receive protection through proper habitat management, research, and education, therefore each objective and strategy contributes to the achievement of the plan's overall goal. The goals and objectives apply to all bats in South Dakota. While there has been no attempt to prioritized efforts by species, it is presumed that conservation efforts will be keyed to local conditions and situations. Resource managers will decide which objectives and strategies to apply under their authority and which ones are most urgent in their area.

Because the South Dakota Bat Management Plan is designed to be adaptive, each participating agency, group, individual, or organization will be asked to provide annual updates and progress reports regarding objectives and strategies they are conducting or have fulfilled. The updates will help refine goals, objectives and specific strategies. In addition, as new information is learned regarding habitat requirements, population data, or other vital information it will be incorporated into future plan revisions.

List of Participants

The South Dakota Bat Management Plan is a cooperative effort between local, state, and federal entities. Alyssa Kiesow (SDGFP) drafted most of the plan, though many individuals throughout the drafting process provided a great deal of help. Doug Backlund (SDGFP) and Joel Tigner (Batworks) provided identifying keys that appeared in the *Mammals Of South Dakota* book, and Joel Tigner, Eileen Dowd Stukel (SDGFP), and Alyssa Kiesow provided articles that appeared in the *South Dakota Conservation Digest.* Individuals who contributed to the plan are listed below. These individuals participated in meetings and provided numerous comments regarding bat conservation and their agencies are potential cooperators in fulfilling this plan.

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General Information and Justification

Introduction

To help familiarize individuals, general information about bats as a group and specific information pertaining to the bat species that occur in South Dakota are included in this management plan. Information includes background knowledge (e.g., natural history), bats and health issues, studies and species in South Dakota, and reasons for bat declines. This information is provided in the general bat information and management justification section as the prelude to the actual strategic plan.

Background

Values and Concerns Worldwide

Bats play an ecological and economic role in their community, which is not duplicated by any other animal group. Worldwide, there are nearly 1,000 species of bats that feed on fruit, nectar, other animals, insects, and even blood. In tropical regions (where bats are most abundant), bats disperse seeds and pollinate flowers by feeding on fruit and nectar, thereby playing a significant role in resource production, plant evolution, and reforestation. An estimated 450 products used by humans are produced by bat-pollinated plants (Laubach et al. 1994). Notable products include food (e.g., bananas and cashews), wood (e.g., balsa), and beverages (e.g., tequila). In the New World tropics, three species of vampire bats are found (Laubach et al. 1994), which drink blood. The anticoagulant found in their saliva has been used for medicinal purposes and has saved lives.

In the United States, and more specifically in South Dakota, bats feed on insects. In South Dakota the role of bats is relatively unknown, but it is suspected that they play a major role in insect population control. For example, it has been reported that little brown bats *(Myotis lucifugus)* may consume 600 insects (e.g., mosquitoes) in one hour (Tuttle 1988), and may play a role in urban mosquito control. Big brown bats *(Eptesicus fuscus)* consume large quantities of beetles and agricultural pests. In one season, one maternity colony of nearly 150 bats consumed 38,000 cucumber beetles *(Diabrotica* spp.), 16,000 June bugs *(Phyllophaga* spp.), 19,000 green and brown stinkbugs (Pentatomida), and 50,000 leafhoppers (Cicadellidae) (Whitaker 1993). Tree-roosting bats (e.g., red bats *[Lasiurus borealis],* hoary bats *[Lasiurus cinereus],* and silver-haired bats *[Lasionycteris noctivagans])* may help maintain forest health by consuming forest pests. Regardless of specifics, it is clear that bats serve a vital function in our ecosystem.

Lack of public awareness and understanding of the value of bats threatens their populations in North America (Luce 1998). Myth, superstition, and folklore continue to contribute to the decline of bat populations. People often associate bats as blood sucking, rabies infected animals that are blind and often tangle themselves in people's hair. European-American culture tends to link bats to evil or evil powers, such as witches and vampires. Contrary to such beliefs, bats are actually unique creatures that benefit humans, and in some cultures (Chinese, for example) are a symbol of good luck and prosperity.

Other factors that may impact bats include human disturbance or destruction of bat habitat. Humans may vandalize roosts such as caves or mines, exclude bats from buildings at inappropriate times or by improper methods (Williams-Whitmer and Brittingham 1996), and disturb roosting bats through recreational and commercial activities such as partying in caves or selective logging. Destruction or degradation of habitat may result from selective harvest

of large trees (Adam et al. 1994, Ochoa 2000, Sedgeley 2001), presence of toxins often introduced through pesticide use (O'Shea and Clark 2001, O'Shea et al. 2001), habitat fragmentation, human disturbance or vandalism at caves (Perkins 1985, Gore and Hovis 1992), and slowly disappearing or degraded riparian zones (Rich 2002). Because these threats may endanger important roosting, foraging, and watering areas, it has become necessary to safeguard critical habitat in order to conserve bat species in South Dakota.

Natural History

Overview

Bats belong to the group of mammals called Chiroptera, which constitutes nearly 1200 species worldwide. Chiroptera literally means hand+wing (MWCD 2002). In fact, bat wings are structured as greatly enlarged hands making them very different from bird wings. As a result of their highly developed wings, bats are the only mammals that have truly mastered powered flight. Other types of mammals can glide (e.g., flying squirrels) but are not capable of sustained flight.

Bats are often compared to rodents, but rodents are flightless and have large paired teeth (incisors) designed for gnawing. Bats are more closely related to primates and have extremely sharp teeth similar to large fangs (canines) found in carnivores. Bats' teeth are not suited for gnawing; instead they are used to puncture and cut apart the hard outer coverings (exoskeletons) of insects.

Physical Characteristics

Most bats in South Dakota have dark brown wing membranes and short brown or gray fur, so it is difficult to distinguish between species. Bat wings - large, five-fingered hands webbed with extremely thin skin stretching from fingertip to shoulder - provide lift and thrust for the animal during flight. Bats use their hind legs and tail, which are enclosed in very thin skin, to maneuver during flight, much like airplanes use ailerons and rudder. Because the wing membranes are so thin, it is easy to see blood vessels along their length. These thin membranes also pose great risk of dehydration, forcing bats to seek roosts with high humidity and minimal air movement. Since bat wings are so fragile and easily damaged, bats utilize their hind feet to move around in their roosts. With short toes and long claws, bat feet are well adapted for hanging upside down. Bats initiate flight from this position by dropping headfirst and spreading their wings.

Bats evolved from small bodied, large brained, insect eating mammals similar to shrews (Laubach et al. 1994). Much like their ancestors, many species of bats (and all of South Dakota's bat species) locate prey and avoid obstacles using a process called *echolocation.* Echolocation is much like the sonar navigational systems used by whales and dolphins. Bats emit high frequency sounds that strike objects (e.g., prey or obstacles) and reflect (echo) back to them, much like Doppler weather radar systems, telling bats the speed, direction, and size of their target (Simmons et al. 1978). Bats are able to adjust their flight accordingly. Once it detects prey, the bat captures it by scooping it up with its wing or tail membranes and transfers the food to its mouth. The bat immediately bites off the insect's wings and legs, and before it loses air speed, quickly chews and swallows the insect's body.

For South Dakota bats, the senses of vision and smell do not play a predominant role in hunting, but their sense of smell does play a significant role in social communication back

at the roost (Bradbury 1977). Most bats apparently lack cones in the retina, a characteristic of many nocturnal animals, but they are still able to see.

Physiology

Like humans, the operating body temperature of most bats is 37°C (98°F) (Lyman 1970). Maintaining body temperatures through internal regulation, called *endothermy* or *homeothermy,* takes a great deal of energy for bats to keep their bodies cool (panting) and warm (fat metabolism) (Licht and Leitner 1967). To conserve important resources, bats can allow their body temperatures to fluctuate with ambient temperatures ranging as high as 43°C (110°F) and as low as 0°C (32°F). This process, which is called *heterothermy,* conserves energy during times of stress (e.g., reproduction) when it is more important to protect body fat reserves than to sustain comfortable body temperatures. Periods of heterothermy are called *torpor* or *hibernation.* Torpor saves energy by reducing body temperature, slowing heart and respiratory rates, and reducing metabolic speed (Humphrey 1982, Luce 1998).

Periods of torpor may last from a few days to several months. Before entering long periods of hibernation, bats must feed excessively to build the large fat reserves needed to maintain body functions throughout the dormancy period. During hibernation, bats may rouse - though only occasionally and for short periods - to urinate, drink, or move to another roost site. During this dormancy period, bats are very sensitive to disturbances, which usually results in "emergency exits from torpor." This emergency activity burns up important energy, and when bats re-enter hibernation, they may no longer have sufficient fat reserves to survive until food and water become available.

During the day, bats often sleep and become semi-torpid. While being semi-torpid, bats are able to slightly reduce their oxygen consumption rates and body temperatures. Also, resting bats often groom themselves using their tongue and their toes. Upon awakening, bats raise their temperatures and increase their consumption rates. Thus, some bats spend much of their life in torpor or in a condition approaching torpor.

Reproduction

During the breeding season, male testes descend into the scrotum in preparation for mating. In South Dakota, bats typically mate in the fall before hibernation, though time of mating varies among species. Because bats are able to postpone egg fertilization or implantation, there is also variability as to when after mating the sperm fertilizes the egg (delayed fertilization) and when the fertilized egg begins development (delayed implantation). Pregnancy lasts approximately 50 to 60 days (Wimsatt 1945, Laubach et al. 1994), and 80 to 90 percent of the females in a nursery colony are reproductively active, depending on the year (Humphrey 1982). Typically, a single young is born in May, June, or late July and, while most species in South Dakota will typically produce only one offspring a year, the red bat *(Lasiurus borealis)* may produce up to four (Jones et al. 1983).

Six of the twelve bat species found in South Dakota are mouse-eared bats of the genus *Myotis,* which produce one young per year (Guthrie and Jeffers 1938, Wimsatt 1944); in some years, as few as 25 to 50 percent of the reproductive-aged females produce single offspring (Barclay et al. 2002). Because of this low reproductive rate, bat populations are more susceptible to dramatic declines in number, which results in subsequent periods of low reproduction.

Mothers usually feed and nurture pups until they become volant and full-grown. Pups and juvenile bats typically cling to their mother's underside, feeding alternately between the two teats located near the mother's armpits. (Most females have two functional mammae located in the chest region, but females of *Lasiurus* have four functional mammae.) Females may carry their young while traveling or foraging until the young become too large for their mothers to remain aloft or too restricting for them to hunt. As a result, young learn very quickly to fly and capture their prey. At 2.5 to 3.0 weeks of age, juvenile bats are nearly full-grown. Many species of bats in South Dakota are known to live an average of 20 years, with their first pregnancy occurring during the second year (Humphrey 1982).

Key Habitats

Foraging habitats vary depending on insect availability, weather, and bat species. Usually, bats forage over water (e.g., lakes, streams, etc.), along forest edges, along rocky escarpments and ravines, and near light sources because these features tend to concentrate insects (Humphrey 1982). Studies in South Dakota and Colorado have shown that small tree stands or water bodies are important features for bats in open prairies (Everette et al. 2001, Swier 2003).

The importance of watering sources is twofold. Most bats require more water than other mammals of comparable weight because their wing membranes have great evaporation surfaces in relation to their weight. Bats are able to drink water while in flight by flying low over the water, lowering their head, and taking a gulp of water. Watering holes also attract insects upon which the bats feed.

Bats roost in a variety of areas. Trees, rock crevices, caves, mines, and man-made structures (e.g., attics, walls or crevices in buildings) provide adequate roost sites for bats. However, some bats in South Dakota even roost under rocks on the ground. Because landscapes differ in South Dakota, all these roosts are important for maintaining bat populations in various areas of the state. Typically, day roosts - including nursery roosts, summer male roosts, transient roosts, and winter roosts (Humphrey 1982) - provide more security and stable conditions than night roosts, which offer areas for rest after feeding sessions. Most roosts are characterized by humid, cool, and dimly lit conditions (Luce 1998).

Nursery and winter roosts are particularly important to bat survival. Nursery roosts must afford protection from predators and provide beneficial microclimates for pregnant or nursing females and developing young (Humphrey 1982). Nurseries are typically located in hot, dark, poorly ventilated areas with several tiny openings. Winter roosts *(hibernacula)* offer bats stable environments, characterized by no air movement, humid conditions, and cool temperatures. Hibernacula typically include caves and mines, attics, walls, or lofts of old buildings, and males and females often share such hibernacula.

South Dakota offers fewer roosting opportunities to bats than are available in other states in the region. Any disturbance or destruction of roosts - particularly nursery or winter roosts - may be limiting factors to bats, not only due to South Dakota's limited roosting opportunities but also due to low reproductive rates and extreme sensitivity of bats to environmental changes (e.g., altered temperatures in hiberacula).

Food Habits

South Dakota bats feast on a wide variety of insects. Soft- or hard-bodied insects are selected as prey, depending on the species of bat. For instance, the diet of big brown bats in

eastern South Dakota includes Coleoptera (beetles), Hemiptera (true bugs), Diptera (flies), and Lepidoptera (moths) (Swier 2003). Generally, size and sturdiness of a bat's skull are correlated with size and hardness of favorite insect prey (Belwood 1979, Freeman 1979). In some instances, though, there may be no correlation. For example, hoary bats have very powerful skulls, yet they prefer soft-bodied insects (S. Pedersen pers. comm.).

Seasonal Behavior

Bats need to migrate or hibernate to survive when harsh northern winters cause insect prey to die and open bodies of water to -freeze. Whether they migrate or hibernate depends on factors relating to animal size, flight characteristics, and proximity to over-wintering sites (e.g., *hibernacula*, Humphrey 1982). Very little is known of the migration routes and the migratory behavior of bats in South Dakota, though they may migrate north-south along the eastern and western state borders and along the Missouri River corridor. Bats may also migrate east-west from the Black Hills to the Missouri River drainage each season, though little concrete evidence is available to verify these movement patterns.

Different species of bats migrate at different times and over varying distances. For example, big brown bats move short distances from summer to winter roosts, while red bats travel long distances to follow warm weather and insect prey (Humphrey 1982). Usually, bats traveling short distances are hibernators traveling to and from their winter roosts, while bats traveling long distances are migrants moving southward with the onset of cool weather and returning northward with the onset of warm weather. In South Dakota, southward migration usually begins in late summer and northward migration usually ends in mid to late spring, while hibernation generally lasts from October to April (Tigner and Dowd Stukel 2003).

Mortality

In general, bat mortality rates are affected by many factors including human activities (e.g., entering roosts at sensitive times of the year, camping in or near caves, releasing environmental toxins, and destroying roost sites). In addition, accidental midair collisions with wind turbines (Johnson et al. 2003), trees, and barbed-wire fences, or accidental groundings during extreme weather may cause bat fatalities (Tuttle 1994). Midair predation by raptors (Byre 1990) and roost predation by snakes, raccoons, and skunks also contribute to bat mortality (Tuttle 1994).

Prenatal mortality is minimal among bats (Humphrey 1982), while newborn and juvenile bat mortalities are associated with litter size, environmental stress, accidents, and predation. Young bats have higher mortality rates than adults. Fatalities to young bats may be caused by crashing into foliage during first flights, being knocked out of the air by large gusts of wind, and being preyed on by owls and other night predators. First year hibernators also seem to suffer high mortality rates (J. Tigner pers. comm.), possibly due to inadequate foraging success and low body weights when they enter their first winter cycle. Most adult fatalities result from accidents, and mortality rates remain relatively constant throughout adulthood.

Bats and Health Issues

Rabies is one disease of many that can be transmitted to humans from wild or domestic animals in South Dakota. Bats are one of many species that can transmit rabies to humans. Rabies is a fatal viral disease infecting the central nervous system (SDDOH 2002).

After infection, symptoms appear in three to eight weeks and may include headache, behavior and sensory changes, paralysis, fever, and malaise.

The South Dakota Department of Health records indicate that skunks are the most prevalent carriers of rabies in the state (Table 1). Since 1990, only 59 of the 1,656 bats tested for the rabies virus in South Dakota proved to be rabies-positive (rabid) - a 4 percent rabies infection rate during this 13-year period (SDDOH 2003a). During 2000, 12 of 357 bats tested positive for rabies, while in 2001, only 11 of 406 bats tested positive for rabies - together, a 3 percent infection rate. In 2002, 9 of 378 bats tested positive for rabies - a 2 percent infection rate (SDDOH 2003a).

Table 1. Number of animals testing positive and negative for rabies in South Dakota, 1990 - 2002 (SDDOH 2003a).

Animal	Positive	Negative	Percent Positive
Skunk	1056	512	67%
Horse	42	240	15
Cattle	189	1633	10%
Bat	59	1597	4%
Dog	87	2380	4%
Cat	76	1597	2%

Most bat rabies cases come from Sioux Falls, Minnehaha County, where the Animal Control Department collects an abundance of bats - the majority of specimens tested in South Dakota - from private residences each year. Most collected bats are sent to and tested by the Animal Diseases Research and Diagnostic Laboratory at South Dakota State University in Brookings. The South Dakota Department of Health (SDDOH) also receives and tests dead bats according to criteria established by the Centers for Disease Control (CDC). Note that the infection rates given here do not represent actual rabies infection rates in wild bats, because they do not represent a random sampling of wild bat populations. Test results, therefore, overestimate the incidence of bat rabies in South Dakota. Nationwide, approximately 10% of bat specimens submitted for rabies testing were positive for rabies (O'Shea et al. 2003), but this number is inflated and does not represent actual infection rates of wild bats (S. Pedersen, pers. comm.).

Rabid bats have been collected in Clay, Davison, Fall River, Lake, Lawrence, Meade, Miner, Minnehaha, Pennington, and Turner counties (SDDOH 2003b). Big brown bats are the most common - and most commonly tested - bats in South Dakota. As a result, over 50 percent of tested rabies-positive bats are big brown bats. Other species that have tested positive include the northern myotis (Myotis septentrionalis), long-legged myotis (Myotis volans), and hoary bat.

Rabies is only transmitted through contact with rabid animals (including bats). Usually, people contract rabies from a bite, scratch, or mucous membrane exposure from rabid animals. Rabies cannot be contracted from droppings or urine. When exposed to rabies, SDDOH recommends seeking immediate medical care. This ensures prompt treatment through post-exposure prophylaxis shots, which prevents rabies in humans. If humans are exposed to rabies, they must have anti-rabies shots to prevent rabies infection and fatality.

Some individuals risk rabies infection through work (e.g., wildlife researchers) or recreational activities (e.g., cavers). To avoid rabies infection, SDDOH recommends pre-exposure rabies vaccination to wildlife researchers working with bats and cavers entering

potential bat roosts. Usually, three shots are given over a three to four week period. These shots do not prevent rabies, though they help ensure complete protection with only two additional booster shots after exposure to rabies. Those individuals should also check their antibody titer every two years, and if it measures below acceptable levels, receive booster rabies shots. (Note: May was declared as Rabies Awareness month in South Dakota on May 3, 2001 by Governor Janklow.)

Some additional diseases affecting bats are histoplasmosis and West Nile virus. Histoplasmosis is a fungal disease that can be transmitted from bats to humans. This disease is most prevalent in droppings of birds and fruit eating bats found commonly in moist, tropical regions. Bats in South Dakota have dry droppings (guano) composed of insect remains; their droppings are unlikely to support the *Histoplasma capsulatum* fungus (S. Pedersen pers. comm.). West Nile virus may infect bats or humans, though this disease is a mosquito-borne infection. At this time, bats are not known to transmit West Nile virus to humans (L. Kightlinger, pers. comm.). West Nile virus may cause mild flu-like illness or severe infection of the brain (SDDOH 2003c).

Like all mammals, bats are infested by ectoparasites including fleas, mites, chiggers, and lice (Humphrey 1982, Laubach et al. 1994), but none of these invertebrates pose a threat to public health.

Bat Studies in South Dakota

Few studies have been conducted in the past in South Dakota. Most current reports belong to unpublished literature, and they generally only note the presence or absence of species from local, regional, and statewide perspectives. Findley (1956) conducted local presence or absence surveys of mammals, including bats, in Clay County South Dakota, while Wilhelm et al. (1981) conducted parallel surveys at LaCreek National Wildlife Refuge. Turner (1974) conducted surveys of mammals, including bats, in the Black Hills, and Froiland and Weedon (1990) conducted similar studies in the Badlands. Over and Churchill (1941 and 1945), Jones and Genoways (1967), Choate and Jones (1981), Sharps and Benzon (1984), and Blumberg (1993) presented checklists or conducted surveys of mammals, including bats, in South Dakota.

Specific bat research includes studies of individual species or surveys of bats in particular areas in South Dakota. Studies of individual species include research by Bole (1934), Moulthrop (1936), Jones and Packard (1958), Long and Severson (1969), Gunier (1971), Tuttle and Heaney (1974), Jones and Choate (1978), and Mattson et al. (1996). Regional surveys include research by Turner and Jones (1968), Turner and Davis (1970), Martin and Hawks (1972), Olson (1977), Farney and Jones (1980), Anderson (1993), Bogan et al. (1996), Choate and Anderson (1997), Cryan et al. (2000), Cryan et al. (2001), Swier (2003), and Lane et al. (2003). Also, a number of unpublished reports exist concerning bat surveys conducted through Wind Cave National Park, Jewel Cave National Monument, the USDA Forest Service, and South Dakota Game, Fish and Parks. Despite this wealth of survey data, relatively little natural history data are available for eastern and central South Dakota, and existing data are limited to presence or absence at single locations.

Species and Status of Bats in South Dakota

Species List

Forty-five species of bats are found in the United States (Pierson 1998). Of these, 12 species of bats have been documented in South Dakota. Four species are considered summer

residents or migratory species, and eight are considered year-round residents (Table 2). Summer resident and migratory species may travel northward and southward as a result of weather changes, and often year-round residents hibernate during cold, winter months.

Table 2. Summer resident or migratory species based on Swier (2003), and year-round resident species based on SDBWG (2002).

Common Name	***Scientific Name***	**Type**
Big Brown Bat	*Eptesicus fuscus*	Year-round resident
Eastern Red Bat	*Lasiurus borealis*	Summer resident
Evening Bat	*Nycticeius humeralis*	Migratory
Fringed Myotis	*Myotis thysanodes*	Year-round resident
Hoary Bat	*Lasiurus cinereus*	Summer resident
Little Brown Myotis	*Myotis lucifugus*	Year-round resident
Long-eared Myotis	*Myotis evotis*	Year-round resident
Long-legged Myotis	*Myotis volans*	Year-round resident
Northern Myotis	*Myotis septentrionalis*	Year-round resident
Silver-haired Bat	*Lasionycteris noctivagans*	Summer resident
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Year-round resident
Western Small-footed Myotis	*Myotis ciliolabrum*	Year-round resident

In January 2003, an eastern pipistrelle *(Pipistrellus subflavus)* was observed hibernating in the Black Hills. This is the first record of an eastern pipistrelle in South Dakota, though vocal signatures were recorded using an AnaBat bat detector in the southern Black Hills at an earlier date (Tigner and Dowd Stukel 2003). Since January 2003, two additional locations were recorded with hibernating eastern pipistrelle. At this time, eastern pipistrelles are not considered migratory or resident species in South Dakota.

Current State Status

In South Dakota, no bats are state listed as threatened or endangered. However, six species are considered rare (S 1, S2, S3), according to the South Dakota Natural Heritage Program (SDNHP), while six bats are considered relatively common (Table 3). Six rare species include the long-eared myotis, fringed myotis, northern myotis, silver-haired bat, Townsend's big-eared bat, and evening bat, while six common species include the little brown myotis, big brown bat, hoary bat, red bat, western small-footed myotis, and long-legged myotis (SDGFP 2002).

South Dakota Natural Heritage Program monitors rare bat species in South Dakota. Information, such as maternity roosts and hibernacula, regarding these species is collected and recorded in the South Dakota Natural Heritage Database. The database helps SDNHP biologists monitor species indicating which species need greater management concern. Each species is ranked, at the global and state level, based on rarity. Listed below are South Dakota bat species and their global and state ranks. Global ranks ("G") indicate the relative status of the species throughout their range, while state ranks ("S") indicate the relative status of the species in South Dakota. Greater abundance relates to high numerical values (e.g., 4 or 5). Ranks report the relative rareness and degree of management concern regarding the species.

Table 3. Rare (above middle line) and common (below middle line) species in South Dakota with global and state ranks as determined by information in the South Dakota Natural Heritage Database, 2003.

Species Name	Common Name	Global Rank	State Rank
Myotis evotis	Long-eared myotis	G5	S1
Myotis thysanodes	Fringed myotis	G4G5	S2
Myotis septentrionalis	Northern myotis	G4	S3
Lasionycteris noctivagans	Silver-haired bat	G5	S4
Corynorhinus townsendii	Townsend's big-eared bat	G4	S2S3
Nycticeius humeralis	Evening bat	G5	S1
Myotis lucifugus	Little brown myotis	G5	S5
Myotis volans	Long-legged myotis	G5	S5
Myotis ciliolabrum	Western small-footed myotis	G5	S5
Eptesicus fuscus	Big brown bat	G5	S5
Lasiurus borealis	Eastern red bat	G5	S5
Lasiurus cinereus	Hoary bat	G5	S5

Rank Definition: G1S1 Critically imperiled because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction. *G2S2* Imperiled because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range. *G3S3* Either very rare and local throughout its range, or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction throughout its range because of other factors; in the range of 21 of 100 occurrences. *G4S4* Apparently secure, though it may be quite rare in parts of its range, especially at the periphery. Cause for long term concern. *G5S5* Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery. *T* Rank of subspecies or variety (SDGFP 2002).

Current Federal Status

The United States Fish and Wildlife Service (USFWS) has not designated any South Dakota bat species as candidate, threatened, or endangered species (Table 4). Whereas, the United States Forest Service (USFS) - Rocky Mountain Region (Region 2 [R2]) including Wyoming, Colorado, and the Black Hills of South Dakota - has three bat species designated as sensitive species two of which occur in South Dakota (Table 4). Both species are located in the Black Hills National Forest in western South Dakota. The R2 Regional Forester's Sensitive Species List provides special management (i.e. Forest Plan Standards) to conserve sensitive species and their habitats on lands managed by the USDA, Forest Service This step is taken in an effort to preclude the need for federally listing of these sensitive species. According to the USFS, "sensitive species" is a term used to describe plants and animals with population viability or habitat capability concerns.

The Western Bat Working Group (WBWG) designates priority ranks to bat species in the western United States. Priority ranks do not provide protection to bats rather they provide information on conservation or management concerns associated with bats. South Dakota is included in this group as Region 9 (Table 4). High priority species may be imperiled or at risk of imperilment, medium priority species are of concern but data regarding species and its threats are lacking, and low priority species are of little concern because existing data suggest species populations are stable and status changes are unlikely. This group published a list to avoid population declines thereby preventing federally listing (WBWG 1998).

Table 4. Federal status of species in South Dakota based on USFWS and USFS designations. Regional priority ranks of species in the western United States, according to the *WBWG Regional Priority Matrix*.

Species Name	Common Name	USFWS	USFS	WBWG
Myotis evotis	Long-eared myotis	-	-	L
Myotis thysanodes	Fringed myotis	-	S	M
Myotis septentrionalis	Northern myotis	-	-	L
Lasionycteris noctivagans	Silver-haired bat	-	-	M
Corynorhinus townsendii	Townsend's big-eared bat	-	S	H
Nycticeius humeralis	Evening bat	-	-	-
Myotis lucifugus	Little brown myotis	-	-	L
Myotis volans	Long-legged myotis	-		L
Myotis ciliolabrum	Western small-footed myotis	-	-	L
Eptesicus fuscus	Big brown bat	-	-	L
Lasiurus borealis	Eastern red bat	-	-	L
Lasiurus cinereus	Hoary bat	-	-	M

Rank Definition: S Identified as sensitive species according *to USFS* in Region *2. L* Identified as *low* priority species, *M* considered medium priority species, and *H* considered high priority species according to WBWG in Region *9.*

Reasons for Bat Declines

Roosting habitats are most affected by human-related threats throughout South Dakota. Roost sites are degraded or destroyed through ill-timed recreational activities in caves (J. Tigner pers. comm.), by sealing closed abandoned mines used as bat roosts (Luce 1998), by destroying tree roosts and removing or reconstructing bridges also used as bat roosts (Swier 2003), and by improperly excluding bats from building or homes (SBWG 2002). In addition, new data suggest that active wind generators may adversely affect bats through collisions resulting in death (Osborn et al. 1998, Keeley et al. 2001).

Much like roosting habitats, foraging areas are most affected by human-related activities. Use of pesticides may threatened bats by presumably reducing or contaminating prey populations thereby reducing prey availability or contaminating bats (O'Shea et al. 2001, Hartman 2002). Contamination or loss of watering sites may affect bat distribution and survival.

Natural threats also affect bat populations in South Dakota, such as disturbances (e.g., extreme winds) or catastrophes (e.g., tornadoes or fire, Pedersen 1996, Adams and Pedersen 1998). Each may destroy habitats or reduce populations. Additional threats include intense predation and reduced prey availability. Reduced prey availability may be the result of reduced species diversity of plants (C. Schmidt pers. comm.).

Management Plan

Introduction

In 1999, the North American Bat Conservation Partnership (NABCP) was developed to provide a framework for willing groups to participate in a cooperative effort to conserve North American bat species (http://www.batcon.org/nabcp/newsite/). NABCP is an alliance of working groups, bat researchers, non-governmental organizations, and state and federal agencies from Mexico, Canada, and the United States. Partners helped create a strategic plan that identifies conservation priorities regarding bat protection. Framework regarding bat protection includes research, education, and management initiatives.

The Western Bat Working Group (WBWG), of which the South Dakota Bat Working Group (SDBWG) is considered an active member, plays an active role in the NABCP. The Western Bat Working Group - formed as a result of conservation efforts regarding Townsend's big-eared bats - includes agencies, organizations, and individuals interested in bat research, management, and conservation from 13 western states and 2 western provinces. The SDBWG works as a partner with the WBWG and therefore the NABCP.

The South Dakota Bat Working Group works to protect bats and bat habitat by conserving bats and their habitats, educating the public, and participating with federal, state, and private landowners. The main objectives are to raise awareness about the roles bats play in maintaining healthy ecosystems and to work with public land managers and private landowners to reduce possible disruptions to bats and their habitat.

Because the SDBWG strives to protect bats and their habitats, the SDBWG, in cooperation with South Dakota Game, Fish and Parks, has taken the lead to develop a five-year state bat management plan. This plan is intended to help guide agencies, organizations, and individuals with bat management throughout South Dakota. Each year during implementation, an evaluation will be conducted to assess the progress of meeting objectives. After five years of implementation, the plan will be thoroughly revisited and appropriate changes will be made.

South Dakota has proposed a management plan with a framework similar to the strategic plan designed by NABCP in order to cooperate with other states on the national level. Three sections comprise the plan: management, research, and education. Each section is critical for conserving bats in South Dakota. The South Dakota Bat Management Plan's list of participants - comprised mainly of SDBWG members - identified potential threats to be addressed through objectives and strategies in each section. Threats are thoroughly described to understand and effectively address the problem. Objectives (specific short- or long-term goals) and strategies (actions) identify efforts that local, private, state, and federal agencies can take and/or continue to take regarding bat conservation in South Dakota. Strategies are not prioritized.

Goal

This plan seeks to initiate new conservation methods and continue current efforts to protect bats in South Dakota. Ultimately, the goal of this plan is to provide guidance for individuals and agencies to promote long-term conservation of South Dakota bat species through research, management, and education.

Threats to Bat Populations

Bats are affected by many factors, eight of which are addressed in this plan. Such threats relate to management, research, or education needs. As a result, objectives and strategies are segregated into one of these areas based on their focus.

Threat 1. Loss of habitat through natural and human-related factors.

Roosting Habitat

Bat populations are thought to be able to withstand and adapt to natural habitat degradation, but intensive human-related threats have a significant impact on bats (Lunney 1990). Loss of roosting habitat (degradation or destruction) can affect large numbers of bats thus protecting and enhancing this habitat is imperative. Roost sites provide areas for resting, rearing young, socializing, and hibernating. Such roost sites include underground structures, buildings, trees, bridges, and rock ledges. In the Black Hills, the greatest threat to caves is human disturbance (J. Tigner pers. comm.), whereas the greatest threat to mines is permanent and improper sealing of the mine for liability purposes or unexpected collapse of the mine due to natural degradation (Luce 1998).

Underground structures (caves and mines) provide hibernacula and maternity roosts, and often these roosts are lost by lack of protection or management. Furthermore, underground structures are limited in the Black Hills, so the loss of these structures is a significant threat to bats, particularly those using caves and mines as hibernacula.

Although the extended importance of bridges and abandoned buildings is relatively unknown, safeguarding bridges and abandoned buildings may help preserve important bat roosts. Often bridges are removed without proper bat surveys, and important bat roosts may be unknowingly destroyed. Aboveground structures like bridges (including box culverts) and abandoned buildings have been noted as bat roosts in South Dakota. Swier (2003) detected big brown bats and little brown bats using concrete bridges and picnic shelters as roost sites, respectively. Frequently, these structures are removed for liability reasons or damaged through natural causes or vandalism.

Living and dead trees in riparian and forested areas provide important roosts for resident and migratory bat species (Lacki and Schwierjohann 2001, Swier 2003). Removal of these habitats (riparian areas and forests) through commercial and residential development, agriculture, and selective forest harvesting destroys possible tree roosts, forage areas, or travel routes (Barclay and Brinham 1998). Silvicultural practices seem to favor monotypic stands, short rotation times, and selective tree harvest leaving minimal roosting habitat for tree-roosting species (Pierson 1998). Also, data show that bats select roost sites in areas with diverse vegetation, old trees, and numerous alternative roosts (e.g., snags, Waldien et al. 2000). Statewide riparian areas are often not specifically managed for bats, though some agencies provide standards and guidelines to protect and enhance riparian areas. Basically, Forest Service standards and guidelines strive to protect basic soil, air, water, and cave resources and provide for a variety of life through management of biologically diverse ecosystems (BHNF 2000). Forested areas in the Black Hills are not specifically surveyed for bats before removing trees for timber harvest (B. Phillips pers. comm.). If bat conservation is a management objective, protection of riparian and forest areas is necessary because riparian areas and other forested corridors (e.g., shelterbelts) connect isolated forested areas to each other providing travel routes for bats. If these travel routes are fragmented, the ability for bats

to move among different forested areas is greatly reduced. In addition, bats use multiple roosts often switching roosts during their active season (Swier 2003).

Snags in early to medium stages of decay are important roosts as bats have been observed roosting underneath the bark and within the hollows of dead trees (Weller and Zabel 2001). Federal forest management include provisions to leave two to four snags (dead trees) per acre as wildlife habitat (BHNF 2000 - Standard 2301), and state forestry works provide snags as well (B. Scott pers. comm.). However, studies show that these numbers are often too low to accommodate the needs of cavity-dwelling species (Pierson 1998, Rabe et al. 1998). Black Hills National Forest Plan also lists standards to provide future snags in areas where snags are below snag objectives by leaving large diameter green trees as snag recruitment (BHNF 2000 - Standard 2304, 2306).

Hibernating bats are susceptible to disturbance, and disturbance is considered one of the greatest threats to bats. During the winter, human disturbances (e.g., surveys, recreational activities, vandalism, and social gatherings), though seemingly small, may wake hibernating bats and cause them to use important fat reserves. Changes in cave or mine temperature due to the presence of humans or loud noises because of human voices or movements seem to affect most hibernators.

Summer maternity roost can also be disturbed as a result of human actions (e.g., removal of roosts, recreational caving activities, and house exclusions). Ill-timed house exclusions may cause roosting females with young to drop their pups while moving to another roost, relocate young to a less suitable roost, or separate from their pups that eventually die.

Often disturbances affect bats during critical phases of their life cycle (e.g., hibernation or reproduction) which has been shown to significantly reduce bat populations.

Foraging Habitat

Bats forage in areas where their prey is most available. Removal of trees can reduce potential foraging areas for bats in treed areas, as prey seems to concentrate near treetops, water sources, or forested edges (Verboom and Spoelstra 1999), yet properly thinned forests may provide foraging areas to bats (Adams and Golten 2003). Pesticides may also affect bats and their prey. Often prey (pest) populations are controlled through pesticide use, which may reduce insect prey numbers making less food available to bats (CWF 2001). In addition, bats may consume insects affected by pesticides. Pesticides remain in insect tissues, and therefore accumulate in the fatty tissues of bats. Pesticides in fatty tissues are released during hibernation, migration, or periods of stress and may be passed to nursing young (McCracken 1986).

Water sources supply water and prey to bats, but bank erosion and pesticide use threaten these water sources. Bank erosion and the resulting loss of riparian vegetation can occur from actions such as livestock grazing, road construction (Grace 2002), urban development (Nelson and Booth 2002), natural flooding, and agricultural practices (Souchere et al. 2003). Livestock with access to riparian areas may trample vegetation (Rich 2002), reducing plant diversity thereby reducing prey abundance. Pesticides used to treat mosquitoes may also kill other insects. Road construction, urban development, and agricultural practices (e.g., row crops) increase sedimentation of streams, which reduces water quality (Grace 2002, Nelson and Booth 2002, and Souchere et al. 2003). As a result, streams, ponds, or lakes may affect drinking water or prey availability for bats.

Threat 2. Regulations or policies associated with protecting bat species and roost sites are inadequate or poorly enforced.

Bats are exposed to increased biological threats (e.g., predation and weather) because of human disturbance. Protecting bats and their habitats is important to maintain population numbers and essential roosts (e.g., caves and mines), but there are few incentives for private landowners to protect bats and their roosts on private lands. Regulatory measures help protect important bat habitats and species and should be updated recurrently as an active part of species management.

State Regulations

State statutes provide some legal protection to bats. All bats in South Dakota are classified as nongame[1] species according to state statutes. Section 34A-8-2 of South Dakota Codified Laws and Constitution states that "the secretary of Game, Fish and Parks shall investigate endangered, threatened, and nongame wildlife to develop information relating to population, distribution, habitat needs, limiting factors, and other biological or ecological data to determine management measures necessary to ensure their perpetuation as viable components to the ecosystems and for human enjoyment." Section 34A-8-6 of South Dakota Codified Laws and Constitution states that "the Department of Game, Fish and Parks and the Department of Agriculture shall perform acts necessary for the conservation, management, protection, restoration, and propagation of endangered, threatened, and nongame species of wildlife." Nongame species are protected unless otherwise noted through law. As a result, nongame species, such as bats, cannot be killed without permission from the state. However, if a bat enters one's living area, by unwritten policy a person will not be reprimanded due to an incidental killing. To collect bats for research purposes, a scientific collector's permit (SDCL 41-6-32) is required. As indicated by section 41-2-18 of South Dakota Codified Laws and Constitution, the Game, Fish and Parks Commission has the option to adopt regulatory measures to provide additional protection or relax protection awarded to wild animals and threatened, endangered, and nongame species.

[1] Nongame species is any wildlife species not legally classified as a game species, furbearer, or threatened or endangered species by statutes of South Dakota (SDCL 34A-8-1).

Federal Regulations

The Federal Cave Resources Protection Act of 1988 (Public Law 100-691, November 18, 1988) provides regulatory measures for federal agencies, particularly the Department of Interior and Department of Agriculture, on federal lands (Appendix E). Federal Cave Resources Protection Act calls for federal agencies to inventory and list significant caves on federal lands and to protect such caves from harm, either to the cave or its biota (e.g., bats and other animals). This act also states that there can be valid reasons for not disclosing cave locations to the general public, which means that cave locations can be kept confidential and protected from Freedom of Information Act (FIA) requests.

Another act associated with bat resources is the National Cave and Karst Research Institute Act of 1998 (Public Law 105-325, Appendix F). This act was designed for the National Park Service to establish and administer a program on cave and karst research and to examine the feasibility of a centralized national cave and karst research institute. Through cooperative efforts by other federal agencies, organizations, experts, and individuals involved with caves, the feasibility study was prepared and forwarded to Congress. As a result,

Congress mandated the National Park Service to establish the National Cave and Karst Research Institute near Carlsbad Caverns National Park in New Mexico. This institute was formed to establish partnerships in order to foster research and education on caves and karsts. Federal funds must be matched by non-federal funds. More specifically, the Institute's mission is to facilitate speleological science, enhance public education, and promote environmentally sound cave and karst management, with bat conservation as a secondary focus. Thus far, partners include Bureau of Land Management, United States Environmental Protection Agency, United States Forest Service, United States Fish and Wildlife Service, and United States Geological Service.

Additionally, the National Park Service (NPS) has guidelines - NPS Natural Resources Management Guidelines - that provide direction on NPS policies, such as the NPS Management Policies. All caves are deemed to fall within the definition of significant cave, therefore they are provided protection and perpetuation of natural cave, karst, and hydrological systems (R. Horrocks pers. comm.). Management policies relating to caves and karst include: 1) managing karst terrain to maintain the inherent integrity of its water quality, spring flow, drainage patterns, and caves, 2) managing caves in accordance with approved cave management plans to perpetuate natural systems associated with caves, such as karst and other drainage patterns, air flows, mineral deposition, and plant and animal communities, 3) protecting wilderness, cultural resources, and values, and 4) preventing development or uses in, above, or adjacent to caves (B. Muenchau pers. comm., R. Horrocks pers. comm.)

Wind Cave National Park (WCNP), in western South Dakota, has a Superintendent's Compendium containing specific regulations to provide public health and safety and protect natural and cultural resources for caves in the park. All caves within the park are considered sensitive, so access is restricted and information regarding caves is confidential and thereby protected from FIA requests (R. Horrocks pers. comm.). In addition to this compendium, WCNP is currently developing a Cave and Karst Resource Management Plan to address management of caves and karst in the park. The main cave, though not considered a significant bat resource, as well as other caves within WCNP are managed to perpetuate natural systems associated with caves (e.g., karst, air flow, mineral deposition, plant and animal communities; M. Ohms pers. comm., D. Foster pers. comm.).

Jewel Cave National Monument (JCNM) and WCNP have active cave policies in South Dakota. JCNM has the only policy that manages a significant bat resource in a manner consistent with bat conservation guidelines. Currently, JCNM is also developing a Cave and Karst Management Plan to address management of caves and karst in the park (R. Ohms pers. comm.). This plan will include formalized policies to protect the large hibernaculum in the historic area of the main cave (R. Ohms pers. comm.).

The Missouri National Recreational River (MNRR) is a component of the National Wild and Scenic Rivers System and is administered by the National Park Service. The MNRR includes 39 miles of relatively free-flowing Missouri River from Ft. Randall Dam to the headwaters of Lewis and Clark Reservoir or approximately Running Water, South Dakota. In addition to the 39 miles above Lewis and Clark Reservoir, the National Park Service administers approximately 59 miles of Missouri River from just below Gavins Point Dam, Yankton SD to Ponca, Nebraska.

Within this section of river, the National Park Service strives to maintain the Missouri River so it functions in its most natural state. The MNRR is managed to ensure that its outstandingly remarkable values, including fish and wildlife, cultural, and historical are not

negatively impacted by any actions along or in the river. The policy for riparian habitat in the MNRR is similar to the river bank stabilization policy of the United States Fish and Wildlife Service, which is stated below. This policy works to protect and preserve river banklines, natural, cultural, and historical resources within the MNRR boundaries (MNRR 1999).

United States Fish and Wildlife Service (USFWS) has a policy regarding cave management (CFR Title 43 - Public Lands: Interior, Subtitle A - Office of the Secretary of the Interior, Part 37 - Cave Management). Cave management regulations seek to manage federal lands in a manner to protect and maintain significant caves and cave resources, as indicated in the Federal Cave Resources Protection Act. Caves or cave resources are deemed significant if the cave has one or more of the following features, characteristics, or values: biota (e.g., bats), cultural, geologic/mineralogic/palentologic, hydrologic, recreational, and educational/scientific. In addition, once caves are determined as significant the USFWS cannot disclose cave locations for purposes other than research.

According to the United States Fish and Wildlife Service, riverine and riparian habitats are high resource priorities in Region 6. USFWS Region 6 has a river bank stabilization policy, which is designed to restore or protect permanent infrastructure or cultural resources associated with riparian areas (USFWS 2001). As a result, any stabilization techniques should be designed to minimize impacts to river functions or impair overbank flooding. Basically, bank stabilization techniques should be assessed prior to implementation to ensure impacts to bank areas are minimal. At present, this policy does not include measures to protect trees for wildlife use (USFWS 2001).

Besides policies to protect significant caves or cave resources and riparian areas (in their natural state), the USFWS provides no management of bat habitat unless resident bat species are listed as threatened or endangered according to the Endangered Species Act (ESA). USFWS does not have jurisdiction to enforce habitat conservation practices relating to bat habitat unless mandated by the ESA. Most emphasis regarding habitat includes "Trust Issues" (e.g., wetlands and migratory birds) and threatened or endangered species, since the USFWS has the authority (N. Gates pers. comm.).

The Black Hills National Forest (BHNF) Land and Resource Management Plan (also referred to the Forest Plan) contains specific "standards" to protect cave resources, mines, and other known bat roost sites. Standard 3207 states, "protect known bat nursery roosts and hibernacula".

The BHNF has started to manage a few caves and mines specifically as significant bat habitat (e.g., gated caves or mines). Maintenance of these gates becomes an issue. Thus far, there has been insufficient forest funding to adequately monitor gated and non-gated bat roost sites (B. Phillips pers. comm.). Since gated caves and mines are not frequently monitored or maintained, vandalism may occur potentially compromising the effectiveness (sometimes for years) of protecting (gating) bat resources (J. Tigner pers. comm.). To date, bat surveys have not been conducted on many caves and mines in the Black Hills, and some of these sites may need protection (e.g., gating).

Riparian areas are protected through South Dakota Best Management Practices (BMPs), which are designed to prevent or minimize the adverse impacts of forestry, agricultural, or recreational activities on water quality. By definition, BMPs are developed to protect water quality and not other functions or values of riparian areas (Phillips et al. 2000). In the Black Hills National Forest, no riparian management zones have been identified. The Forest Plan contains standards and guidelines that refer to water influence zones. In these

zones, only actions that maintain or improve long-term stream health and riparian ecosystem condition are allowed (BHNF 2000). As a rule, logging does not occur in these zones without some stream course protection. Livestock grazing in these areas is required to meet `utilization standards' (BHNF 2000). Additional emphasis by the BHNF should be placed on evaluating this grazing intensity and, where needed, improve protection of these riparian areas and natural spring sources (B. Phillips pers. comm.).

Several agencies or groups provide information pertaining to conservation concerns relevant to bats in South Dakota. These agencies or groups include the USFS, SDGFP, and WBWG. Each designates rankings, maintains databases and observation records, or recommends management actions all without a cohesive link (refer to pages 9-10).

Threat 3. Insufficient interagency cooperation, funding sources, and educational outreach impact the effectiveness of conserving bats in South Dakota.

In the past, few organizations have taken steps to cooperate with other groups to manage or conserve bats in South Dakota. Although the SDBWG has initiated education, research, and conservation efforts in South Dakota, cooperative efforts across the state among state and federal agencies and the private sector are still minimal at best. Despite *`interagency memoranda of understanding and agreements'*, lack of funding and lack of *priority* have generally made these documents ineffective and short on substance soon after signing. To ensure the success of this plan, decision-makers should see bat conservation as a management priority.

At this time, several funding sources are available for research activities associated with nongame and often these funding sources are not widely known. Some of these funds are appropriated year to year and are not a guaranteed source of funds. Most funding sources are temporary. Funding sources include State Wildlife Grants (federal grants), Wildlife Diversity Program Small Grants, Wildlife Division monies, and Section 6 Endangered Species Act (ESA) Grants (Dowd Stukel 2003).

Threat 4. Inadequate standardized methods associated with monitoring or surveying bat species.

A standardized approach to monitoring efforts across the state would significantly improve our ability to measure the progress of achieving the management plan goal and to gauge the effectiveness of the management plan. As information associated with bat monitoring, biological needs, and habitat selection improve, the need to verify and standardize monitoring and surveying techniques increase, which ensures the accuracy and utility of this additional information.

South Dakota Department of Game, Fish and Parks (SDGFP) provides bat sampling and collection protocol guidelines for bat researchers that is available on the SDGFP Wildlife Diversity Program homepage (http://www.state.sd.us/gfp/DivisionWildlife/Diversity/index.htm) or SDBWG homepage (http://nat_hist.sdstate.edu/SDBWG/SDBWG.htmi). Increased interest in bats in the Black Hills led to concerns regarding impacts of sampling and collecting local bat populations, which prompted the designation of this protocol. This protocol states specific requirements and guidelines for bat sampling and collecting associated with research and monitoring in South Dakota and allows SDGFP to collect information regarding bat researcher qualifications and current/previous bat research methodologies and to review bat research and monitoring projects proposed for South Dakota.

The BHNF includes information pertaining to monitoring and evaluating sensitive species in their Land and Resource Management Plan, though these requirements are general and do not specify particular variables to collect or areas to visit during specific time periods. The approach involves general information of collecting and storing monitoring data and requires data collection every three years but does not involve or suggest standard methods.

Because bat research methodologies vary per species, region/habitat, and researcher, the implementation of a single bat research protocol is not proposed in this document. Although research methodologies vary, monitoring efforts should be standardized. Standardizing monitoring efforts (e.g., time spent surveying a site) will reduce redundant data collection and decrease disturbance to bats at important roosts during critical periods (e.g., lactation in females). Data consistency is a key component in obtaining meaningful data (e.g., surveying the same cave at the same time under similar conditions) (Petryszyn 1995). Effective bat conservation relies on gathering appropriate information to recognize population changes regarding bat species, especially those of conservation concern.

The WBWG is currently working with the USFS Pacific Northwest Research Station (Arcata, CA) to develop a set of guidelines for monitoring, surveying, and inventorying bats.

Threat 5. **Data and knowledge associated with natural history are lacking regarding bats in South Dakota, and due to inadequate awareness regarding regional bat research efforts, participation as a cooperative unit is lacking.**

Limited knowledge of factors affecting bat populations and insufficient data regarding aspects of bat natural history hinder bat conservation efforts. Conservation efforts throughout the United States are being designed and implemented with negligible documentation regarding the value in alleviating damage or enhancing habitats for bats. As a result, biologists are taking efforts to fill these information gaps by investigating species distributions, population trends, and habitat requirements.

At this time, information is limited to bat species in western South Dakota, particularly the Black Hills. Data gaps relating to bats include long-term monitoring of sites or populations, population status, population distribution, foraging habitats and habits, roosting sites, migratory patterns, effects of wind power, reproductive strategies, population structure, and genetic structure, particularly in central and eastern South Dakota. Bats are difficult to study, which limits a detailed understanding of their natural history. Factors making research difficult include extreme mobility, widely dispersed populations (some species), nocturnal activity patterns, and cryptic and/or inaccessible roost sites (Petryszyn 1995).

Current data have not been summarized nor reviewed to evaluate where research priorities lie because data are not readily accessible. Understanding which habitats (e.g., roosting and foraging areas) are selected by bats and are suitable for bats will help prioritize conservation efforts in order to favor the most critical sites. Databases help identify variables consistently collected by researchers and help manage an accumulation of data generated from various surveys. In order to recognize information gaps and research goals, current knowledge needs to be identified.

Research and monitoring of bats in South Dakota are important to conserve these species. Being aware of and participating in regional efforts associated with bats is an effective method of increasing an understanding of regional bat habits and habitats. Currently, aside from participation in the WBWG, few organizations, agencies, or individuals in South Dakota participate in any regional efforts regarding bats. Few programs are designed to monitor or research bats in a specific region, though some programs exist. For example,

some states (e.g., Minnesota) have adopted a program to monitor bats in mines in the Great Lakes region called the Great Lakes Regional Bat Conservation Initiative. Such efforts could be designed for the Great Plains Region.

Some programs are designed for national and international participation. Bat Conservation International (BCI) has taken the lead role to research and conserve bats thereby designing several research-oriented programs. Generally, these programs are designed to encourage state, federal, private, or individual entities to survey and enhance bat habitat. Three programs developed by BCI include the Bat House Project, Bats and Mines Project, and Bats in Buildings Project. Currently, agencies, organizations, and individuals in South Dakota have participated minimally in these efforts (M. Kiser pers. comm.).

Threat 6. Insufficient use of data associated with bats in South Dakota is a problem that can be changed by creating appropriate management recommendations.

Although data have been collected on bats in some regions of South Dakota, collected information is relatively unknown and thereby used inadequately. Data associated with bats may be applied to many areas: research, monitoring protocol, and management. Generally, management refers to conserving and protecting bats in South Dakota using various techniques or decisions. Establishing certain management recommendations may protect areas near rivers, in the Black Hills, and in large cities.

Often management recommendations are based on a variety of agencies, organizations, and individuals, therefore emphasis, interpretations, and formats may differ. This causes confusion among different groups or individuals concerning proper bat conservation methods. In order to alleviate confusion, universal management recommendations can be designed incorporating formats, interpretations, and ideas of groups and individuals with active policies or recommendations. To create these universal management recommendations, past recommendations should be reviewed. This will take cooperation among agencies and summarization of past data. Data can be used to bridge research findings and make management recommendations to resource managers.

By developing a general list of management recommendations, managers will essentially be provided with a condensed version of the South Dakota bat management plan. This offers a quick reference of some very important management steps to groups or individuals concerned with conserving bats in South Dakota. In addition, management recommendations will help guide managers with future research. As a result, it is important to analyze data, understand interpretations, recognize formats, and apply information towards identifying management recommendations related to bats.

Threat 7. **Inadequate knowledge of bats is a problem that plagues many areas, particularly South Dakota, and contributes to loss of individual bats, unnecessary rabies testing of bats, lack of protection of roost sites, and poor understanding of bats.**

Many people have an incomplete understanding of bats and their habitats. Negligible information sources and limited opportunities for school activities and volunteer programs are available for all ages to become knowledgeable in bat ecology. Education is the foreground of understanding, which often leads to the protection of bat species. The consequence of insufficient knowledge is increased anthropogenic (human related) threats to bats by the public sector. By informing the public about bats and their ecology, human associated threats to bats will hopefully be reduced. For example, people in Austin, Texas once sought to eradicate bats because they believed bats caused problems. Bat Conservation International

(BCI) educated people on the ecological and economic value of bats in this city. Consequently, people in Austin cherish their bats and consider Austin the "Bat Capitol of America". Tourists even travel to Austin to observe emerging bats.

Currently, the South Dakota Bat Working Group (SDBWG) has a website (http://nat_hist.sdstate.edu/SDBWG/SDBWG.html) that includes information pertaining to bats in South Dakota. This website includes bat facts, proper bat exclusions, bat species found in South Dakota, current and past research, educational tools, and other bat related information. Also, South Dakota Game, Fish and Parks (SDGFP) has several publications or educational tools concerning bats. These include AcroBATS of the Night (poster and activity booklet), Sharing Your Space: a homeowner's guide to attracting backyard wildlife, Bat Trunk, School Programs in the Black Hills, and Bat Awareness Week (2" d week in August). In addition, BCI has numerous educational materials related to bats for all age groups. Efforts by these groups may have helped protect bats, but bats are still unnecessarily killed for rabies testing and improperly excluded from roosts; misperceptions still plague many groups and individuals.

Folklore, myth, and superstitions involving bats have masked the ecological and economic role these species play in their ecosystems. For example, few bats carry rabies and few human rabies cases result from bat strains of the virus. Also, bats do not become tangled in one's hair, and no bats are vampires in the United States. Unjustifiable public perception presents a serious threat to bats. For approximately 20 years, public awareness concerning the value of bats has increased though lack of knowledge remains a hindrance to bat protection. Often agencies, organizations, educators, and individuals lack essential resources to inform the public to dispel misconceptions associated with bats. By educating the public, they may learn of the value of bats and ways to assist with their conservation. Education will help the public develop an appreciation for the role bats play, dispel myths and misperceptions associated with bats, create an awareness of human related threats to bats, and encourage students to maintain and/or create habitats suitable for bats. This will help to conserve bats in South Dakota.

Management Needs

There are specific management needs vital to protecting bats in South Dakota. Conserving bat habitats, enforcing regulations or policies, improving interagency cooperation, and locating additional funding sources are issues that require special emphasis to improve bat conservation.

HABITAT

Issue 1.1. - Caves and Mines

Bats residing year-round in South Dakota often use caves and mines as hibernacula or other roosts (e.g., maternity roosts). Caves on federal lands are protected through the Federal Cave Resources Protection Act of 1988 (Refer to Threat 2). Also, several caves are managed as bat hibernacula to protect hibernating bats (Tigner and Dowd Stukel 2003), and these caves are located on public lands (J. Tigner pers. comm.). Law does not protect mines, though several mines are managed and protected as bat habitat (Tigner and Dowd Stukel 2003). Mines are frequently being improperly closed (in reference to bats) due to liability issues or collapsing due to poor support within the walls. As part of their management, cave and mine

entrances are protected with "bat-friendly" gates to sustain current environmental conditions, allow bats to access the roost, and prevent human disturbance at critical times. Access by humans in managed caves is only restricted during the winter, while access in other managed mines is restricted year-round (J. Tigner pers. comm.). Because proper roosts are already limited in the Black Hills and slowly being depleted, it is necessary to continue protecting and restoring caves or mines in this region of South Dakota.

Objective 1.1.
Protect and restore bat caves and mines (e.g., hibernacula) and assess progress in the next five years. Continue to maintain and inventory protected caves and mines on federal and private properties.

Strategy 1.1A.
Evaluate mines (marked for closure on public lands or funded for closure by public monies) through biological survey and monitoring by bat biologists before closure to determine significance of bat habitat. Develop Black Hills-wide education process (e.g., newspapers, schools, and radio/TV PSA) for existing and new landowners that may have mine audits.

Strategy 1.1B.
Identify and determine whether those caves or mines have significant habitat for bats then prioritize caves or mines requiring *protection (e.g.,* gate placement, gate reconstruction, or other means).

Strategy 1.1C.
Protect at least 10 additional caves or mines through landowner cooperation (on private or public lands), cost-share, and other means. Contact and cooperate with State Preservation Officers, where appropriate (see National Historic Preservation Act at **http://www.achn.gov/NHPApdf)**. Investigate funding opportunities for cost share on private land closures. Note: *Protection* generally refers to gating but can include other human exclusion methods such as sign placement or road closure.

Strategy 1.1D.
Monitor significant hibernacula and maternity roosts through surveys, especially gated mines and caves.

Strategy 1.1E.
Cooperate with and educate the Paha Sapa Grotto (e.g., caving groups) to minimize inappropriately timed cave explorations and increase supervised, cooperative cave surveys by promoting compliance with the state's monitoring protocol. Develop a schedule of times, in one year, to avoid specific caves to prevent unnecessary bat disturbances.

Strategy 1.1F.
Cooperate and coordinate with regional private consultants, state biologists, and federal biologists to minimize repetitive cave surveys during the bat hibernation or

maternity period. Develop a survey schedule, in two years, identifying and recording specific surveys and survey times.

Strategy 1.1G.
Step up efforts to contact and cooperate with commercial cave operations in an attempt to improve communication and perhaps minimize negative effects of cave tours on bats. Develop a seasonal closure schedule, in one year, when bats are most susceptible to disturbance (e.g., maternity roosts and hibernacula), and make this schedule available to commercial cave owners.

Strategy 1.1H.
Provide cave and mine location data only to approved (approval requires understanding bats, conforming to bat educational materials and protocols, and providing better overall protection of bats through site or surrounding habitat) managing organizations such as federal, state, and private entities (unless caves are commercial) to restrict access to data. Communicate and cooperate with the Paha Sapa Grotto to keep non-commercial cave locations confidential, particularly cave locations with bats of special concern.

Issue 1.2. - Forested Habitat

Several bats (e.g., red bats, hoary bats, and silver-haired bats) depend on trees as habitat, while most bats forage near trees or vegetation in search of insect prey. Roosts may be found under bark, in holes or crevices, and amongst branches or limbs of both living and dead trees. Dead trees - *snags* - in the early to middle stages of decay provide good habitat for many tree-roosting species (e.g., bats) but other tree roosts are essential for many types of wildlife, including bats (Mattson'et al. 1994, Waldien et al. 2000). In addition, foraging areas usually are found above or in the tree canopy. Removing trees particularly relating to over-story canopy affects availability of roosts (Adam et al. 1994) and potential foraging areas (Verboom and Spoelstra 1999).

Objective 1.2.
Provide federal, state, and private entities with bat habitat management guidelines for forest and/or riparian areas where wildlife, including nongame wildlife, is a primary and secondary forest management objective that will increase the available bat roosting habitat to approximately 8.5 dead trees (> 12 " dbh) per acre by 2009 in forest areas.*

**Desired density of snags on forested lands for ideal bat habitat (Mattson et al. 1994).*

Strategy 1.2A.
Work with government (state and federal) and private foresters to encourage retention of a minimum of eight large snags per acre, particularly in riparian areas or in areas of known bat roosting sites, by preserving existing snags whenever possible (except where snags would have a severe negative affect on harvest operations or would cause a public safety hazard).

Strategy 1.2B.
Work with foresters, in areas where no snags exist, to encourage leaving at least eight large live trees per acre that can be preserved for future snag needs or created into snags and to leave at least 25-30% of salvage logging and fuelwood cutting areas as patches of land with large trees (dead or alive) representative of the entire stand for bat habitat.

Strategy 1.2C.
Work with land and resource managers to share information and management recommendations relating to bat roosts. Include information, recommendations, and procedures on how to maintain and enhance forest stands and riparians areas for bat habitat, survey timber sale areas for bat roosts, identify bat roosts for protection, and where appropriate, modify silvicultural activities to promote bat habitat.

Issue 1.3 - Riparian Areas and Water Sources

Aforementioned foraging areas usually are found above or in the tree canopy, but bats may also feed above or near riparian corridors. Removing or degrading riparian vegetation may affect water quality (Grace 2002, Nelson and Booth 2002, and Souchere et al. 2003) and plant diversity thereby affecting opportunities for bats to feed by reducing prey abundance (e.g., invertebrates; Verboom and Spoelstra 1999) and to drink by contaminating or eliminating water sources. Springs, seeps, ponds, creeks, and other wet areas provide feeding and drinking areas to bats, thus protecting these water sources is twofold.

Objective 1.3.
Protect and improve water sources and associated riparian areas to protect important feeding and drinking areas (and potentially roosting areas) for bats.

Strategy 1.3A.
Work with foresters, range specialists, and landowners to maintain and improve water influence zones and riparian areas by allowing only those actions that maintain and/or improve riparian ecosystem condition. Manage riparian areas to produce quality riparian communities by retaining woody vegetation along steam and lakes and providing large woody material in streams or lakes. Attempt to retain natural stream features (e.g., shallows), limit direct access to water (through fencing where applicable), retain and/or plant bank-side streams, and discourage season-long riparian grazing pastures (where applicable).

Strategy 1.3B.
Work with foresters, range specialists, and landowners to maintain and improve springs, seeps, ponds, or other wet areas as water sources. Attempt to retain natural features, protect water quality from livestock and pollutants, and protect springs sources (through fencing).

Strategy 1.3C.
Work with foresters, range specialists, and landowners to maintain and improve the management, production, and health of the nation's privately (through governmental

programs) and publicly owned grazing land, while protecting riparian areas and wetlands through allowable use or residual level practices.

Issue 1.4. - Bridges

Bridges - including box culverts - are known to provide roost habitat for bats in other regions (Keeley and Tuttle 1999). Bridges may have crevices or swallow nests (Tigner 1999) in which bats roost, however, the significance of these potential roost sites in South Dakota is relatively unknown. The schedule for bridge removal is not often communicated to enable bat surveys prior to removal. If bat surveys can be performed, bridges may be determined as important thus allowing bats to be appropriately excluded from the roost (bridge) and properly relocated to an alternative roost (e.g., bat house). In addition, surveys may help determine which bridge designs best support bats and other wildlife.

Objective 1.4.

Protect and enhance bat roosts associated with crevices or swallow nests in bridges or box culverts in five years.

Strategy 1.4A.

Make information available to surveyors of bridges and box culverts to increase awareness of bat use of these habitats. Provide funding for bridge or box culvert surveys. Determine which bridge and box culvert designs are used most frequently and/or may enhance use by bats in South Dakota and encourage construction crews, government agencies, county road crews, and private landowners to use these designs where feasible.

Strategy 1.4B.

Educate and cooperate with construction crews, government agencies, county road crews, and private landowners to protect roost bridges and box culverts by promoting sealing procedures to crevices (-30 cm deep and 2.5 cm wide) during appropriate times and with proper techniques and personnel. Sealing procedures are best completed when bats no longer use bridge or box culvert crevices as roosts. Replace sealed bridge or box culvert crevices with artificial roosts.

Strategy 1.4C.

Maintain and protect swallow nests by minimizing nest destruction. Create new bridge and box culvert roosts by constructing and placing artificial bat roosts under bridges. Improve culvert/bridge design specifications to include roost structures in all new construction or reconstruction. Attempt to protect or enhance 10 bridges or box culverts in five years. Use volunteers for additional help.

Issue 1.5. - Buildings

Some bats select human residences as their roosts, and most homeowners do not like the presence of bats in their homes. Therefore, these homeowners seek help from pest control groups or attempt to exclude bats from their homes by themselves. Few pest control groups have taken steps to actually conduct bat exclusions, and many that conduct bat exclusions are unaware of the life cycle and persistence of bats in roosts thereby excluding bats in a manner

that may negatively affect them. As well, homeowners are unaware of proper exclusion methods, which results in exclusion efforts during critical times in the bats' life cycle (e.g., during summer months). Bats roosting in homes during the summer may have young and are therefore highly susceptible to disturbance. Females or young may perish due to stress. The best method to exclude bats is performing a humane exclusion and providing alternate housing. Learning these proper bat exclusion methods is important to conserve bats.

Objective 1.5.
Promote bat friendly exclusions in houses or buildings with bat roosts -promote alternative roosts through artificial structures in these situations.

Strategy 1.5A.
Provide information to pest control groups regarding bat friendly exclusion procedures - SDBWG. Encourage house or building exclusions during appropriate seasons, with appropriate techniques, and by appropriate personnel during a period when bats are absent. Conduct at least one (educational) workshop and produce written informative material addressing these issues in one year.

Strategy 1.5B.
Develop a list of pest control operators practicing bat friendly house exclusions in one year. Provide homeowners with this list of pest control operators upon their request. Update this list every two years - SDBWG.

Strategy 1.5C.
Encourage entities providing bat exclusions to participate in certification program sponsored by Bat Conservation International (BCI). (Bat exclusionists are certified and listed on the BCI web site by being insured and licensed in the states they serve and using approved bat exclusion methods.)

Strategy 1.5D.
Provide easily accessible information (e.g., website, posters, and brochures) to pest control operators, homeowners, and educational facilities regarding proper timing and methods of conducting house or building exclusions and general background knowledge concerning bats. Encourage the construction and erection of bat houses and other artificial bat structures to provide potential roosts for excluded bats.

REGULATIONS

Issue 2.1. - Regulations

Caves and karst are protected by the Federal Cave Resources Protection Act of 1988 (Refer to Threat 2). In addition, several federal agencies have policies and/or management plans that protect caves and karst formations but do not necessarily translate to protection for roost habitat in these caves. Because bats use a wide array of habitats, it is necessary to evaluate and establish protection policies relating to all bat habitats in South Dakota. State and federal agencies should work together to enforce current regulations relevant to all bat habitats in South Dakota.

Objective 2.1.
Review regulations associated with bat habitats and recommend revisions (including incentive based protections) where necessary. Develop a policy statement from the SDBWG partners.

Strategy 2.1A.
Determine interpretation and evaluate implementation of policies and regulations associated with bats and their conservation. Work towards a broader understanding of bat policies and regulations over an ongoing timeframe.

Strategy 2.1B.
Review and summarize policies and regulations associated with roost sites (e.g., caves/mines) in South Dakota. Develop a list of recommended changes or additions to policies and regulations associated with bats and their habitat as needed.

Strategy 2.1C.
Provide information regarding regulations and policies associated with bat habitats to agencies, organizations, and individuals. Encourage increased enforcement of policies and regulations by managers and gain public support for protecting bat habitats. Use regulations and policies to guide management decisions.

Issue 2.2. - Species Status

According to South Dakota Codified Laws and Constitution (34A-8-1), bats are classified as nongame species (unless listed as a threatened or endangered species) and are protected as such. Also, the Game, Fish and Parks Commission has the opportunity to adopt additional rules to further protect threatened, endangered, or nongame species in the state (E. Dowd Stukel pers. comm.). Although six species of bats are considered species of concern according to the SDNHP, no state protection beyond their nongame status is provided to these species. Little legal protection is awarded to bats in federal lands unless they are listed as a threatened or endangered species. Only two species are considered R2 sensitive species in the BHNF (B. Phillips pers. comm.). Communication and cooperation are key to developing adequate official status regulations. Through research and communication, state and federal agencies can strive towards better protection of bats. Hopefully, this will alleviate the need for special status.

***Objective** 2.2.*
Each year review species `status' lists, particularly rare species monitored by the Natural Heritage Database, in South Dakota.

***Strategy** 2.2A.*
Review official status (e.g., rare, threatened, or endangered species) of bat species, and initiate changes as necessary. Update these lists annually with changes based on state monitoring data and range-wide status. Recommend to agencies throughout South Dakota to review and reevaluate the official status of their priority species. Prioritize management needs and actions based on species status.

Strategy 2.2C.
Promote awareness and involvement with agencies throughout South Dakota and publics with regards to official species status. Provide information regarding bats and their value, protection status, and (if available) conservation incentives.

Strategy 2.2D
Encourage the Game, Fish and Parks Commission to adopt additional rules if determined necessary -to protect threatened, endangered, and nongame species as indicated by SDCL 41-2-18. Make similar recommendations, as needed, to the USFWS, USFS, BLM, and NPS.

INTERAGENCY COOPERATION

Issue 3.1. - Information Sharing

The South Dakota Bat Working Group has identified improved coordination methods among different groups or individuals to assist in managing bats in South Dakota. Coordination involves communication and cooperation between agencies, organizations, and individuals, essential steps to fulfilling the goal of this plan. In the future, additional efforts should be taken to increase knowledge and therefore conservation of bats in South Dakota.

Objective 3.1.
Develop cooperation and involvement between different agencies, organizations, or citizens concerning bats through shared research and information exchange over the next five years.

Strategy 3.1A.
Promote increased attention and awareness in government and tribal agencies or other organizations of bat issues by requesting and providing information to these agencies or organizations. Invite these agencies or organizations to interact in information exchanges and develop better management of bats and their habitats.

Strategy 3.1B.
Endorse interagency and wide-ranging cooperation and interest by conducting three workshops (e.g., Sioux Falls, Rapid City, and Pierre) each year. Workshops include information exchange concerning bats and safe house exclusion. Workshops will attempt to reach publics like pest control operators, homeowners, teachers, biologists, and managers.

Strategy 3.1 C.
Communicate with landowners and land managers at workshops or in person to create a good working relationship. Identify opportunities to work with landowners and/or land managers to protect and enhance habitats for bats.

Issue 3.2. - **Funding Sources**

Funding sources are available for nongame research, though many agencies, organizations, and individuals are not aware of these funding opportunities (Refer to Threat 3). Nongame research or education may or may not involve bats, and often money allocation

is competitive making monies difficult to obtain. Also, some funding sources are dependent on state or federal budgets, and monies may not be available each year. Therefore, agencies, organizations, and individuals should cooperate in making the best use of available funding sources and furthering available funding opportunities.

Objective 3.2.
Publicize funding sources and funding needs for bat research. Use available funding sources or opportunities for high priority bat research needs.

Strategy 3.2A.
Work with local, private, state, and federal agencies to identify available funding sources. Investigate opportunities and attempt to increase funding sources available for bat research, management, and/or education in two to three years. Publicize likely or potential funding sources, through personal communication, workshops, websites, and posters explaining ways to obtain funding for bat research to qualified groups or individuals over five years. SDBWG will update funding sources via website each year.

Strategy 3.2C.
Publicize funding opportunities to appropriate groups or individuals. For example, an annual research review meeting is held between South Dakota State University and South Dakota Game, Fish and Parks.

Research Needs

In South Dakota, research gaps exist regarding bats and their natural history. Therefore, research to fill these gaps becomes important to understanding bats residing or migrating through South Dakota in order to properly manage these species. Issues addressed in this section include data compilation, monitoring protocol, permits and their requirements, funding sources, and research goals.

RESEARCH PROTOCOL AND PERMIT

Issue 4.1.

Technology is advancing and research emphasis is changing, thus more researchers have shown increased interest in studying and monitoring bats. Bats are very sensitive to stress even stress that seems minimal, such as research activities. This emphasizes the need for establishing research protocols to reduce the potential of harming bats associated with repeated surveying and data collection. To prevent sickness or death to bats as a result of stress, specific guidelines and requirements (protocols) need to be identified for bat researchers. Researchers collecting data on bats in South Dakota must first apply for a South Dakota Collector's Permit and adhere to conditions of this license as a permittee.

Objective 4.1.
Develop protocols and review permit requirements for bat researchers and identify appropriate revisions on an annual basis.

Strategy 4.1A.
Develop protocols to provide researchers with uniform survey methods for data collection and guidance on mine and cave issues. Review and summarize permit requirements for bat researchers each year. Make necessary changes associated with these requirements.

Strategy 4.1B.
Design a program for monitoring bats in South Dakota, particularly caves and mines, in two years. Record time and number of visits, sites visited, and frequency of visits to guide researchers and biologists with monitoring surveys.

Strategy 4.1C.
Incorporate monitoring protocol as part of permit requirements for bat researchers in two years.

DATABASE SUMMARY AND RESEARCH

Issue 5.1. - Database

Because data regarding all bat research in South Dakota is not easily accessible or completely compiled, current knowledge and information gaps associated with South Dakota bats are not entirely known. As a result, data should be compiled and made accessible to biologists, managers, and researchers. Databases provide readily available information to professionals for tracking rare species and arranging regional survey efforts. Furthermore, creating an organized database will help organize and analyze data to understand bats residing in and migrating through South Dakota. Additionally, the sensitive nature of some of the data requires development of "special considerations", which will guide data distribution.

Objective 5.1.1.
Develop a database with resources, previous research efforts, trend data, and research techniques per specific locations for bats in South Dakota to match past and future efforts in two years.

Strategy 5.1.1A.
Create a database through state funding, which includes data collected from South Dakota, to help standardize monitoring methods, reduce survey repetition, and provide bibliographical information (e.g., literature sources) to bat researchers, regional biologists, and individual citizens. Database will be maintained by SDGFP.

Strategy 5.1.1B.
Provide data, upon request and after scrutiny, to our region (South Dakota, North Dakota, Wyoming, Nebraska, etc.) regarding current information and research techniques relative to bats.

Objective 5.1.2.
Summarize current knowledge on natural history and literature resources on each bat species in South Dakota in two years.

Strategy 5.1.2A.
Analyze database and determine the relative population trend of each bat species in South Dakota.

Strategy 5.1.2B.
Develop distribution maps and status reports for individual resident and migrant bat species in two years.

Strategy 5.1.2C.
Compile current information regarding maternity roosts and hibernacula in two years. Due to data sensitivity, this information will only be released when special consideration is given to each request and information remains confidential.

Strategy 5.1.2D.
Review research findings relative to migratory patterns in two years.

Issue 5.2. - Future Research

Research is important to understanding bats in South Dakota, particularly for conservation purposes. At present, research needs concerning bats in South Dakota appear to focus on natural history and hibernacula. Researcher, managers, and biologists throughout the state identified the following research needs based on past information and current observations. Time and finances may affect research needs in the future. At some point, analyzing current data and identifying current research needs are necessary to further understand and conserve bats in South Dakota.

Objective 5.2.
Conduct bat research based on research needs and secure financial assistance (where possible) to accomplish research. Future research needs (listed below as strategies) cover various issues associated with bats.

Prioritized Research Strategies

Strategy 5.2A.
Identify hibernacula and maternity roosts of bats, particularly for Townsend's big-eared bats, and identify sites for gate installations. Determine the effective size of buffer zones (based on each site) needed around occupied caves and/or mines.

Strategy 5.2B.
Continue to gather information on reproductive rates, home range, and movement patterns of each species, particularly rare species, in each region of the state. Continue to save and process bats tested by SDDOH each year (important for distribution, and reproductive data). Create GIS maps of high bat activity (e.g., roosting, foraging, or hibernating) and bat distributions in South Dakota for purposes of planning.

Strategy 5.2C.
Census bats along non-urban riparian corridors to understand the value of these habitats for foraging and roosting and as migration routes. Monitor bats along the

Missouri River and identify the importance of this river system for migrating bats. Survey bridges and box culverts along these riparian corridors to determine location and type (e.g., swallow nests or crevices) of bat roosts.

Strategy 5.2D.
Investigate and determine impact of plant diversity and structure on bat activity at bat foraging habitats. Determine the diets of each bat species and the relationship between invasive plant species, insect availability, and bat foraging success.

Strategy 5.2E.
Create a database of reference calls using AnaBat and Petterson bat detection systems.

Strategy 5.2F.
Determine the abundance and diversity of prey and investigate the impacts of pesticides on prey abundance and diversity and the effects on bats.

Strategy 5.2G.
Analyze the potential threats in areas selected as high priority for wind power generation and determine the effects of wind power generation sites on migratory bat populations in South Dakota.

Strategy 5.2H.
Investigate responses of bats to fire, whether prescribed, wild, or other disturbance and/or catastrophe.

Strategy 5.21.
Continue to gather information on population genetic structure and evolutionary affinities of bat species and/or subspecies throughout the state.

Strategy 5.2J.
Examine the role bats play in contributing to the control of pest populations in South Dakota. Explore integrated pest management techniques for agricultural areas.

Additional Research Strategies

Strategy 5.2K.
Determine the effects of selective timber harvest on bat populations in the Black Hills. Employ experimental design for determination of effects before and after timber harvest.

Issue 5.3. - Modification of Research Needs

Research needs change through time. As specific research needs are addressed, new needs will be identified. New research often stems from old or past research.

Objective 5.3.
Evaluate and revise research topics every five years. Complete research topics depending on available resources, identify topics that require more time and emphasis, and regularly reevaluate research priority list.

Strategy 5.3A.
Conduct research based on research topic priority list as permitted or required during plan implementation.

Strategy 5.3B.
Continue to identify additional research needs for future planning. Record new research topics needing focus and revise research priority list after five years.

Issue 5.4. - Cooperative Research

In the past, South Dakota as well as other areas have not received much research attention associated with bats, though researchers are becoming increasingly interested in bats in this area. As a result, cooperative efforts by numerous groups or individuals will help increase understanding of regional bat habits and habitats helping conserve them. At this time, no regional research or monitoring organizations has been established for groups or individuals in the western region (e.g., SD, ND, MT, WY, CO, ID, CA, AZ, NM, TX, NV, OR, and WA). Therefore, there is need for cooperative research efforts in the western region, for established program members but also through new research programs.

Objective 5.4.
Investigate regional research topics or efforts, particularly those amongst western states, and cooperate as opportunities and monitoring activities arise. Participate in relevant and logistically feasible research and/or monitoring projects in the region in three to five years.

Strategy 5.4A.
Survey current biologists' research and regional (e.g., western states) bat research topics or efforts, and identify any projects or efforts South Dakota may want to join in two years. Revisit cooperative projects or efforts periodically.

Strategy 5.4B.
Develop cooperative research or monitoring projects in South Dakota to compliment efforts in other states in the western region in three years.

MANAGEMENT RECOMMENDATIONS

Issue 6.1.

This plan provides a list of *management recommendations* (Refer to Appendix D) from available local information and management advice. However, new research needs to be periodically reviewed and analyzed to continually refine and improve these recommendations. In addition, data collection and monitoring by agencies and individuals in South Dakota needs to be consulted and considered whenever these management recommendations are revised.

Objective 6.1.
Keep current on new scientific information to improve the list of management recommendations. Reevaluate the current list of management recommendations every two years, or as information becomes available.

Strategy 6.1A.
Itemize research findings and reports as it pertains to bat species and their conservation in South Dakota. Create a priority list of changes to current *management recommendations.*

Strategy 6.1B.
Determine how agencies or groups may use better use *these management recommendations.* Identify the most accommodating format and best method of distribution in two years.

Education Needs

Education provides the foreground to understanding bats in South Dakota. Through education, the public and professionals alike may learn about the value of bats and seek to conserve them. Education needs include understanding of public viewpoints, informative workshops, and information tools.

PUBLIC OUTREACH

Issue 7.1.

In South Dakota, public attitudes toward bats are relatively unknown. Many regard bats as a nuisance species or fear bats as a result of lack of awareness. Human related activities are a major threat to bats. As a result, it is important to evaluate public attitudes towards bats and determine focus groups for educational efforts hopefully reducing unnecessary killing of bats.

Objective 7.1. - Public Attitudes
Determine public and public educator attitudes towards bats. Inform the public (e.g., educators, students, pest control operators, public officials, agencies, and special interest groups or private organizations) of bat ecology and discuss the importance of bats by using different techniques (e.g., workshops, fieldwork, etc) each year.

Strategy 7.1A.
Incorporate questions related to bats and their conservation needs in public attitude surveys conducted by SDGFP in one year.

Strategy 7.1B.
Use relevant findings of attitude surveys to shape direction of public information efforts. Familiarize public (e.g., educators, students, pest control operators, public officials, agencies, and special interest groups or private organizations) with bat ecology and bat species. Encourage media (e.g., television and newspaper) coverage on bats, particularly as critical components of ecological health.

Strategy 7.1C.
Promote and obtain public involvement and develop opportunities for public assistance (e.g., educators, students, and special interest groups) with bat conservation and management activities (e.g., habitat enhancement via snag production or bat house/roost construction and erection).

Strategy 7.1D.
Target information messages to specific topics, such as the number of bats tested for rabies by the South Dakota Department of Health along with rabies infection rate, improper house exclusions by pest control operators, or unnecessary disturbances to bats. Identify specific opportunities to reach publics (e.g., agencies, pest control operators, and special interest groups) during specific times (e.g., annual meetings and license renewals).

Issue 7.2. - **Informational Tools**

Minimal efforts have been taken to establish effective bat informational tools due to money and time constraints. Informational tools provide proper information to the public concerning bats and their habitats and are easily distributed to various groups. Hopefully, by identifying and developing effective informational tools, public misperceptions and unawareness will change to public interest and concern regarding bats and their habitats. This will help increase bat conservation in South Dakota.

Objective 7.2.
Identify effective information tools to address lack of adequate information or misinformation concerning bats and distribute to the public (e.g., educators, students, pest control operators, public officials, agencies, and special interest groups or private organizations). Update and renew informational tools as required.

Strategy 7.2A.
Identify and develop informational tools, such as posters, brochures, and short videos, to distribute to different publics (e.g., educators, students, pest control operators, public officials, agencies, landowners, and special interest groups or private organizations) throughout the state in one year. Update and renew informational tools as needed.

Strategy 7.2B.
Investigate the effectiveness of informational tools through surveys. Identify more effective informational tools according to certain publics (e.g., educators, students, pest control operators, public officials, landowners, agencies, and special interest groups or private organizations) and distribute informational tools to appropriate publics.

Summary Statement

Because bats are threatened by factors that range from loss of habitat to the publics' lack of knowledge, three sections in the management strategy were designated: *management, research, and education* needs. *Management* needs addressed issues relating to protecting

important bat roosts or habitat (e.g., caves and mines), investigating and improving regulatory measures, developing interagency cooperation, and publicizing or utilizing potential funding opportunities. *Research* needs focused on issues relating to establishing a database of current information on bats, developing monitoring protocol, identifying future research goals, and creating cooperative research and managing efforts. *Education* needs included information relating to understanding and respecting bats in South Dakota through informational tools. Major threats were identified, which created individual portions in the management plan. In each portion, issues, objectives, and strategies were addressed. Objectives were more broad-based and strategies were more specific relative to actions for achieving overall goals. Objectives and strategies associated with bat management may help guide various agencies or entities with protecting bat species in South Dakota.

With this management plan for bats in South Dakota, the South Dakota Bat Working Group (SDBWG) seeks to gain increased public and interagency support and awareness in addition to increased conservation of bats and their habitats.

Progress Evaluation

During the five-year implementation period of the state bat management plan, an annual review of the document is scheduled. Groups, agencies, organizations, and individuals participating in the plan will be asked to provide annual progress reports. These reports will be incorporated into the SDBMP annual progress report.

By conducting an annual review of the state bat management plan, the SDBWG will be able to measure the progress of strategy implementation or completion, determine areas needing greater focus, and assist in updating the plan. Time frames associated with strategies will also evaluated during the annual review and revisions will be made if needed.

Upon the completion of the annual progress evaluation, information regarding the progress of the plan will be available via SDBWG and SDGFP websites for public review. After the five-year implementation period is completed, an overall evaluation of the plan will be conducted.

List of Potential Cooperators

Listed below are local, state, federal, or tribal entities, which may cooperate in conserving bat species in South Dakota. Currently, some entities may actively conserve bat species in a manner consistent with this plan, though this plan will hopefully be used for all potential cooperators to strive in similar direction. Through cooperative efforts, this plan will more effectively conserve bat species in South Dakota.

Badlands National Park	http://www.nps.gov/badl/exp/home.htm
Barrick Gold Corporation	http://www.barrick.com/
Bat Conservation International	http://www.batcon.org/
Batworks	
Black Hills State University	http://www.bhsu.edu/
Bureau of Land Management	http://www.blm.gov/nhp/
Cheyenne River Sioux Tribe	http://www.sioux.org/
Crow Creek Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/crwcreek.htm
Custer National Forest	http://www.fs.fed.us/r1 /custer/
Dakota Prairie Grasslands	http://www.fs.fed.us/rl/dakotaprairie/
Flandreau Santee Sioux Tribe	http://www.fsst.orv-/
Jewel Cave National Monument	http://www.nns.gov/jeca/index.htm
Lower Brule Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/lwrbrule.htm
Missouri National Recreational River	http://www.nps.gov/mnrr
Natural Resources Conservation Service	http://www.nrcs.usda.gov/
Nebraska National Forest	http://www.fs.fed.us/r2/nebraska/
Oglala Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/oglala.htm
Rosebud Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/rosebud.htm
Sisseton-Wahpeton Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/sisseton.htm
South Dakota Department of Environment and Natural Resources	http://www.state.sd.us/denr/denr.html
South Dakota Department of Game Fish and Parks	http://www.sdgfp.info/Index.htm
South Dakota Department of Health	http://www.state.sd.us/doh/
South Dakota Department of Transportation	http://www.sddot.com/
South Dakota National Wildlife Refuges	http://mountain-prairie.fws.aov/refuges/sd
South Dakota State University	http://www3.sdstate.edu
Standing Rock Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.orp-/profiles/strock.htm
State Historic Preservation Office	http://www.sdhistorv.orp-/
The Nature Conservancy	http://nature.org/
University of South Dakota	http://www.usd.edu/
US Army Corp of Engineers	http://www.usace.army.mil/
US Army National Guard	http://www.arng.army.mill
US Bureau of Reclamation	http://www.usbr.aov/main/
US Fish and Wildlife Service	http://www.fws.pov/
US Geological Survey	http://www.usgs.gov/
USDA Forest Service, Black Hills National Forest	http://www.fs.fed.us/r2/blackhills/
USDA Forest Service, Rocky Mountain Research Station	http://www.fs.fed.us/rm/
Wharf Mine (Goldcorp Inc.)	http://www.anie.com.au/mines/au/Wharf.htm
Wind Cave National Park	http://www.nps.pov/wica/Home.htm
Yankton Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/yankton.htm

List of Personal Communications

Dowd Stukel, Eileen. April 2003. South Dakota Department of Game, Fish and Parks.

Foster, Dan. March 2004. National Park Service (Wind Cave National Park).

Gates, Natalie. April 2003. United States Fish and Wildlife Service.

Kightlinger, Lon. March 2003. South Dakota Department of Health.

Kiser, Mark. July 2003. Bat Conservation International.

Muenchau, Barbara. February 2003. National Park Service (Wind Cave National Park).

Ohms, Marc. March 2004. National Park Service (Wind Cave National Park).

Ohms, Renee. March 2004. National Park Service (Jewel Cave National Monument).

Pedersen, Scott. December 2002. South Dakota State University.

Phillips, Bradley. April 2003. United States Forest Service (Black Hills National Forest).

Schmidt, Cheryl. December 2003. BS Biological Services/USDA Rocky Mountain Research Station.

Scott, Brian. March 2003. South Dakota Department of Agriculture.

Tigner, Joel. April 2003. Batworks.

Literature Cited

Adams, R. A., and L. Golten. 2003. Preliminary data for the effects of forest thinning on bat foraging patterns in Boulder County, Colorado. Presentation at the 33rd Annual North American Symposium on Bat Research. Lincoln, Nebraska, USA, 8-11 October 2003.

Adams, R. A., and S. C. Pedersen. 1998. The effects of natural disasters on bat populations on Montserrsat BWI: a 20-year history. American Zoologist 38: 52. Abstract only.

Adam, M. D., M. J. Lacki, and T. G. Barnes. 1994. Foraging areas and habitat use of the Virginia big-eared bat in Kentucky. Journal of Wildlife Management 58: 462-469.

Allen, J. A. 1874. Notes on the natural history of portions of Dakota and Montana territories. Proceedings of the Boston Society of Natural History 17: 33-48.

Allen, J. A. 1895. List of mammals collected in the Black Hills region of South Dakota and in western Kansas by Mr. Walter W. Granger, with field notes by the collector. Bulletin of the American Museum of Natural History 7: 259-275.

Anderson, J. M. 1993. Bats of Jewel Cave National Monument, South Dakota. M. S. Thesis, Fort Hayes State University, Hays, Kansas, USA. 29pp.

Anderson, K. W., and J. K. Jones. 1971. Mammals of northwestern South Dakota. University of Kansas Museum of Natural History 19: 361-393.

Barclay, R. M. R., and R. M. Brinham. 1998. Hide and seek: in search of forest bats. Bats 16: 3-7.

Barclay, R. M. R., J. Ulmer, C. J. A. Mackenzie, M. S. Thompson, L. Olson, J. McCool, E. Cropley, and G. Poll. 2002. Variation in reproductive rates of bats: correlations and life-history implications. Presentation at the 32nd Annual North American Symposium on Bat Research. Burlington, Vermont, USA, 6-9 November 2002.

Belwood, J. J. 1979. Feeding ecology of an Indiana bat community with emphasis on the endangered Indiana bat, *Myotis sodalis.* M. S. Thesis. University of Florida, Gainesville, Florida, USA. 130pp.

Blumberg, C. A. 1993. Use of a mail survey to determine present mammal distribution by county in South Dakota. M. S. Thesis. South Dakota State University, Brookings, South Dakota, USA. 136pp.

BHNF (Black Hills National Forest). 2000. Phase I amendment of Forest Plan standards and guidelines homepage. http://www.fs.fed.us/r2/blackhills/projects/planning/amend 2001/00 11 02 Standards pddf 26 December 2003.

Bogan, M. A., J. G. Osborn, and J. A. Clark. 1996. Observations on bats at Badlands National Park, South Dakota. Prairie Naturalist 28: 115-123.

Bole, B. P. 1934. *Myotis thysanodes* in South Dakota. Journal of Mammalogy 16: 147-148.

Bradbury, J. W. 1977. Social organization and communication. Pages 1-72 in W. A. Wimsatt, editor. Biology of bats (Volume 3). Academic Press, NewYork, New York, USA.

Byre, V. J. 1990. A group of young Peregrine Falcons prey on migrating bats. Wilson Bulletin 102: 728.

CWF (Canadian Wildlife Federation). 2001. Getting Started: Pesticides homepage. http://www.wildaboutgardening.org/en/get started/section4/index.htm 31 December 2003.

CDC (Centers for Disease Control and Prevention). 2003. West Nile virus: background homepage. http://www.cdc.gov/ncidod/dvbid/westnile/background.htm 2 July 2003.

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

Choate, J. R., and J. M. Anderson. 1997. Bats of Jewel Cave National Monument, South Dakota. Prairie Naturalist 29: 39-47.

Coats, G. W. 1945. Some observations on wildlife in the Black Hills during the last sixty-five years. South Dakota Conservation Digest 12: 10-11, 15.

Cryan, P.M., M.A. Bogan, and J.S. Altenbach. 2000. Effect of Elevation on Distribution of female bats in the Black Hills, South Dakota. Journal of Mammalogy 81: 719-725

Cryan, P.M., M.A. Bogan, and G.M. Yanega. 2001. Roosting habits of four bat species in the Black Hills of South Dakota. Acta Chiropterologica 3: 43-52.

Dowd Stukel, E. 2003. Summary of Wildlife Diversity Program and Natural Heritage Database funding sources. South Dakota Game, Fish and Parks, Pierre, South Dakota, USA. 1 pp.

Everette, A. L., T. J. O'Shea, L. E. Ellison, L. A. Stone, and J. L. McCance. 2001. Bat use of a high-plains urban wildlife refuge. Wildlife Society Bulletin 29: 967-973.

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

Findley, J. S. 1956. Mammals of Clay County, South Dakota. University of South Dakota Publications in Biology 1: 1-45.

Freeman, P. W. 1979. Specialized insectivory: beetle-eating and moth-eating molossid bats. Journal of Mammalogy 60: 467-479.

Froiland, S.G., and R. R. Weedon. 1990. Natural History of the Black Hills and Badlands. Center for Western Studies, Augustana College, Sioux Falls, South Dakota, USA. 225pp.

Grace, J. M. 2002. Sediment movement from forest road systems: roads-a major contributor to erosion and stream sedimentation. Engineering & Technology for a Sustainable World 9: 13-14.

Gore, J. A., and J. A. Hovis. 1992. The southeastern bat: another cave-roosting species in peril. Bats 10: 10-12.

Gunier, W. J. 1971. Long-distance record for movement of a gray bat. Bat Research News 12: 5.

Guthrie, M. J., and K. R. Jeffers. 1938. Growth of follicles in the ovaries of the bat *Myotis lucifugus lucifugus.* Anatomical Record 71: 477-496.

Hartmann, R. 2002. Lead-induced "hardness of hearing" in bats: a reason for their decline? Myotis 40: 5-9.

Hayden, F. V. 1862. Mammals. Pages 138-151 *in* On the Geology and Natural History of the Upper Missouri. Transactions of the American Philosophical Society No. 12.

Hoffman, W. J., and M. D. Late. 1877. List of mammals found in the vicinity of Grand River, Dakota Territory. Proceedings of the Boston Society of Natural History 19: 94-102.

Humphrey, S. R. 1982. Bats: Vespertilionidae and Molossidae. Pages 52-70 *in J. A*. Chapman and G. A. Feldhamer, editors. Wild Mammals of North America. Johns Hopkins University Press, Baltimore, Maryland, USA.

Johnson, G. D., W. P. Erickson, and M. D. Strickland. 2003. Avian interactions with wind power structures. *In R*. L. Carlton, editor. Proceedings of an Electric Power Research Institute (Concord, CA) Workshop. Jackson Hole, Wyoming, USA, 16-17 October 2002.

Jones, J. K., and R. L. Packard. 1958. *Myotis keenii septentrionalis* in South Dakota. Journal of Mammalogy 39:150.

Jones, J. K., and H. H. Genoways. 1967. Annotated checklist of bats from South Dakota. Transactions of the Kansas Academy of Sciences 70: 184-196.

Jones, J. K., and J. R. Choate. 1978. Distribution of two species of long-eared bats of the genus *Myotis* on the Northern Great Plains. Prairie Naturalist 10: 49-52.

Jones, J. K., D. M. Armstrong, R. S. Hoffman, and C. Jones. 1983. Mammals of the northern Great Plains. University of Nebraska Press, Lincoln, Nebraska. 379pp.

Keeley, B. W., and M. D. Tuttle. 1999. Bats in American Bridges. Resource Publication No. 4, Bat Conservation International, Austin, Texas, USA.

Keeley, B., S. Ugoretz, and D. Strickland. 2001. Bat ecology and wind turbine considerations. Proceedings of the National Avian-Wind Power Planning Meeting 4: 135-146.

Keleher, S. 1996. Guano: bats' gift to gardeners. Bats 14: 15-17.

Lacki, M. J., and J. H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forest. Journal of Wildlife Management 65: 482-488.

Lane, J.E., C.L. Buck, and R.M. Brigham. 2003. The bat fauna of southeast South Dakota. Prairie Naturalist 35:246-256.

Laubach, C. M., J. Bowles, and R. Laubach. 1994. A guide to the bats of Iowa. Iowa Department of Natural Resources, Des Moines, Iowa, USA. 32pp.

Licht, P., and P. Leitner. 1967. Physiological responses to high environmental temperatures in three species of microchiropteran bats. Comparative Biochemistry and Physiology 22: 371-387.

Long, C. A., and R. G. Severson. 1969. Geographical variation in the big brown bat in the north-central United States. Journal of Mammalogy 50: 621-624.

Luce, B. 1998. Wyoming bats: wings of the night. Wyoming Wildlife 62: 17-32.

Lunney, D. 1990. The case for bat conservation. Bats 8: 12-13.

Lyman, C. P. 1970. Thermoregulation and metabolism in bats. Pages 301-331 *in W. A.* Wimsatt, editor. Biology of bats (Volume 1). Academic Press, New York, New York, USA.

Martin, R. A., and B. G. Hawks. 1972. Hibernating bats of the Black Hills of South Dakota: distribution and habitat selection. Bulletin of the New Jersey Academy of Science 17: 24-30.

Mattson, T. A., N. L. Stanton, and S. W. Buskirk. 1994. The roosting ecology of the silver-haired bat *(Lasionycteris noctivagans)* in the Black Hills of South Dakota. National Biological Survey: Midcontinent Ecological Science Center, Fort Collins, CO. 34 pp.

Mattson, T. A., S. W. Buskirk, and N. L. Stanton. 1996. Roost sites of the silver-haired bat *(Lasionycteris noctivagans)* in the Black Hills, South Dakota. Great Basin Naturalist 56: 247-253.

McCracken, G. F. 1986. Why are we losing our Mexican free-tailed bats? Bats 3: 1-2.

Moulthrop, P. N. 1936. *Myotis volans interior* in South Dakota. Journal of Mammalogy 17: 413-414.

MWCD (Merriams-Webster Collegiate Dictionary). 2002. Collegiate dictionary: Chiropteran homepage. http://www.m-w.com/cpi-bin/dictionary?va=chiropterans 21 November 2002.

MNRR (Missouri National Recreation River). 1999. Final General Management Plan and Environmental Impact Statement. National Park Service, Report NPS D-9A, United States Department of Interior. 281 pp.

Nelson, E. J., and D. B. Booth. 2002. Sediment sources in an urbanizing, mixed land-use watershed. Journal of Hydrology 264: 51-68.

NSE (NatureServe Explorer). 2002. NatureServe Explorer: an online encyclopedia of life homepage. http://www.natureserve.orp-/explorer/ 23 Dec 2002.

Ochoa, J. 2000. Diversity of small mammals in extracted woods in low forest lands of the Guiana Venezuelan. Biotropica 32: 146-164.

Olson, R. 1977. Hypogean ecology of Jewel Cave National Monument, Custer County, South Dakota. M. S. Thesis. University of Illinois, Champaign-Urbana. 96pp.

Osborn, R. G., K. F. Higgins, C. D. Dieter, and R. E. Usgaard. 1998. Bat collisions with wind turbine in southwestern Minnesota. Bat Research News 37: 105-108.

O'Shea, T. J., and D. R. Clark. 2001. Overview of impacts of contaminants on bats: with special reference to the Indiana bat. Bat Research News 42: 36.

O'Shea, T. J., A. L. Everette, and L. E. Ellison. 2001. Cyclodiene insecticide, DDE, DDT, arsenic, and mercury contamination of big brown bats *(Eptesicus fuscus)* foraging at a Colorado Superfund site. Archives of Environmental Contamination and Toxicology 40: 112-120.

O'Shea, T. J., R. A. Bowne, L.E. Ellison, C. E. Rupprecht, V. Shankar, and J. H. Winsatt. 2003. The Fort Collins bats and rabies study: overview and progress report. Presentation at the 2"d Four Corners Regional Bat Conference. Durango, Colorado, USA, 29 January-1 February 2003.

Over, W. H., and E. P. Churchill. 1941. Mammals of South Dakota. University of South Dakota, Vermillion, South Dakota, USA. 56pp.

Over, W. H., and E. P. Churchill. 1945. Mammals of South Dakota. University of South Dakota, Vermillion, South Dakota, USA. 56pp.

Pedersen, S. C., H. H. Genoways, and P. W. Freeman. Notes on bats from Monterrat (Lesser Antilles) with comments concerning the effects of Hurricane Hugo. Carribean Journal of Sciencev32: 206-213.

Perkins, M. 1985. The plight of *Plecotus.* Bats 2: 1-2.

Petryszyn, Y. 1995. Bat monitoring protocol for the ecological monitoring program in Organ Pipe Cactus National Monument, Arizona. Spec. Rept. No. 11, Coop. Parks Studies Unit, Univ. Arizona, Tucson, AZ.

Phillips, M. J., L. W. Swift, and C. R. Blinn. 2000. Best management practices for riparian areas. Pages 273-286 *in E.* S. Verry, J. W. Hornbeck, and C. A. Dolloff, editors. Riparian Management in Forests of the Continental Eastern United States. Lewis Publishers, Boca Raton, Florida, USA.

Pierson, E. D. 1998. Tall trees, deep holes, and scarred landscapes: conservation biology of North American bats. Pages 309-325 *in T.* H. Kunz and P. A. Racey, editors. Bat biology and conservation. Smithsonian Institution Press, Washington, D.C.

Rabe, M.J., T. E. Morrell, H. Green, J. C. deVos, and C. R. Miller. 1998. Characteristics of ponderosa pine snag roosts used by reproductive bats in northern Arizona. Journal of Wildlife Management 62: 612-621.

Reagan, A. B. 1907. Animals, reptiles, and amphibians of the Rosebud Indian Reservation, South Dakota. Transactions of the Kansas Academy of Sciences 21: 163-164.

Rich, T. D. 2002. Using breeding land birds in the assessment of western riparian systems. Wildlife Society Bulletin 30: 1128-1139.

SDBWG (South Dakota Bat Working Group). 2002. South Dakota Bat Working Group homepage. http://nat hist.sdstate.edu/SDBWG/SDBWG.html 8 April 2002.

SDDOH (South Dakota Department of Health). 2003a. Rabies homepage. http://www.state.sd.us/doh/Pubs/rabies.htm 31 December 2003.

SDDOH (South Dakota Department of Health). 2003b. Bat Rabies in South Dakota, 1993 to 2002. South Dakota Department of Health, Pierre, South Dakota, USA. 1 pp.

SDDOH (South Dakota Department of Health). 2003c. West Nile virus in South Dakota homepage. http://www.state.sd.us/doh/WestNile/index.htm 2 July 2003.

SDGFP (South Dakota Department of Game, Fish and Parks). 2002. Rare, threatened or endangered animals tracked by the South Dakota Natural Heritage Program homepage. http://www.state.sd.us/gfp/DivisionWildlife/DiversitY/RareAnimal.htm 15 March 2002.

Sedgeley, J. A. 2001. Quality of cavity microclimate as a factor influencing selection of maternity roosts by a tree-dwelling bat, *Chalinolobus tuberculatus,* in New Zealand. Journal of Applied Ecology 38: 425-438.

Sharps, J. C., and T. A. Benzon. 1984. Compiled list of South Dakota wildlife. South Dakota Department of Game, Fish and Parks, Rapid City, South Dakota, USA. 27pp.

Simmons, J. A., M. B. Fenton, and M. J. O'Farrell. 1978. Echolocation and pursuit of prey by bats. Science 203: 16-2 1.

Souchere, V., C. King, N. Dubreuil, V. Lecomte-Morel, Y. Le Bissonnais, and M. Chalat. 2003. Grassland and crop trends: role of the European Union Common Agricultural Policy and consequences for runoff and soil erosion. Environmental Science and Policy 6: 7-16.

Stebler, A. M. 1939. Ecological study of the mammals of the Badlands and the Black Hills of South Dakota and Wyoming. Ecology 20: 382-393.

Suthers, R. A. 1966. Optomotor responses by echolocating bats. Science 152: 1102-1104.

Suthers, R. A. 1970. Vision, olfaction, and taste. Pages 265-309 *in W. A.* Wimsatt, Editor. Biology of bats (Volume 1). Academic Press, New York, New York, USA.

Swier, V. J. 2003. Distribution, roost site selection, and food habits of bats in eastern South Dakota. M.S. Thesis. South Dakota State University, Brookings, South Dakota, USA. 105pp.

Tigner, J. 1999. Bat Surveys and Habitat Use in Western South Dakota. *In:* South Dakota Wildlife Diversity Small Grants Results and Reports for 1999. South Dakota Game, Fish, and Parks, Pierre, South Dakota, 2003. GFP Report 2003-04.

Tigner, J., and E. Dowd Stukel. 2003. Bats of the Black Hills: a description of status and conservation needs. South Dakota Department of Game, Fish and Parks, Wildlife Division Report 2003-05, Pierre, South Dakota, USA. 94pp.

Turner, R. W., and J. K. Jones. 1968. Additional notes on bats from western South Dakota. Southwestern Naturalist 13: 444-447.

Turner, R. W., and W. H. Davis. 1970. Bats from the Black Hills of South Dakota. Transactions of the Kansas Academy of Sciences 72: 360-364.

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

Tuttle, M. D., and L. R. Heaney. 1974. Maternity habits of *Myotis leibii* in South Dakota. Bulletin of the Southern California Academy of Science 73: 80-83.

Tuttle, M. D. 1988. America's Neighborhood Bats: understanding and learning to live in harmony with them. University of Texas Press, Austin, Texas, USA. 96pp.

Tuttle, M. D. 1994. The lives of Mexican free-tailed bats. Bats 12: 6-14.

USFWS (United States Fish and Wildlife Service). 2001. Policy on streambank stabilization projects homepage. http://www.r6.fws.gov/pfw/PDFiles/bankersosl Othrev.pdf 31 December 2003.

Verboom, B., and K. Spoelstra. 1999. Effects of food abundance and wind on the use of tree lines by an insectivorous bat, *Pipistrellus pipistrellus.* Canadian Journal of Zoology 77: 1393-1401.

Wackenhut, M., and M. McGraw. 1996. Idaho's Bats: description, habitats, and conservation. Idaho Wildlife 16.

Waldien, D. L., J. P. Hayes, and E. B. Arnett. 2000. Day-roosts of female long-eared myotis in western Oregon. Journal of Wildlife Management 64: 785-796.

WBWG (Western Bat Working Group). 1998. Western Bat Species: Regional Priority Matrix. Western Bat Working Group Workshop. Reno, Nevada, USA, 9-13 February 1998.

Weller, T. J., and C. J. Zabel. 2001. Characteristics of fringed myotis day roosts in northern California. Journal of Wildlife Management 65: 489-497.

Whitaker, J. O. 1993. Bats, beetles, and bugs. Bats 11: 23.

Wilhelm, R. B., J. R. Choate, and J. K. Jones. 1981. Mammals of LaCreek National Wildlife Refuge, South Dakota. Special Publications of the Museum, No. 17, Texas Tech University, Lubbock, Texas, USA. 37pp.

Williams-Whitmer, L. M., and M. C. Brittingham. 1996. A homeowner's guide to northeastern bats and bat problems. College of Agricultural Sciences, Cooperative Extension, Pennsylvania State University, University Park, PA. 22pp.

Wimsatt, W. A. 1944. Growth of the ovarian follicle and ovulation in *Myotis lucifugus lucifugus.* American Journal of Anatomy 74: 129-173.

Wimsatt, W. A. 1945. Notes on breeding behavior, pregnancy, and parturition in some vespertilionid bats of the eastern United States. Journal of Mammalogy 26: 23-33.

Appendices

Appendix A. Taxonomy

The 1200 species of bats alive today belong to the Order Chiroptera, which is the second largest group of mammals behind Rodentia. All bats found in North America belong to the Suborder Microchiroptera (small bats), and all bats found in South Dakota belong to the Family Vespertilionidae. Forty-two genera and 324 species comprise the Vespertilionidae family worldwide (Nowak 1999). Of the 42 genera, *Myotis* includes nearly 100 species alone and has the widest worldwide distribution of any genus of bat (Nowak and Paradiso 1983). Six genera are found in South Dakota: *Lasiurus, Lasionycteris, Myotis, Corynorhinus, Eptesicus,* and *Nycticeius.* All Vepertilionids are primarily insectivorous. In South Dakota, 12 species of bats have been documented (NSE 2002, SDBWG 2002):

Eastern Red bat	*Lasiurus borealis* (Muller 1776)
Hoary bat	*Lasiurus cinereus* (Palisot de Beauvois 1796)
Silver-haired bat	*Lasionycteris noctivagans* (LeConte 1831)
Northern myotis	*Myotis septentrionalis* (van Zyll de Jong 1979) (Prey. *M keenii)*
Little brown myotis	*Myotis lucifugus* (Thomas 1904)
Western small-footed myotis	*Myotis ciliolabrum* (van Zyll de Jong 1984) (Prey. *M leibii)*
Fringed myotis	*Myotis thysanodes* (Jones and Genoways 1967)
Long-eared myotis	*Myotis evotis* (Allen 1864)
Long-legged myotis	*Myotis volans* (Miller 1914)
Big brown bat	*Eptesicus fuscus* (Young 1908)
Townsend's big-eared bat	*Corynorhinus townsendii* (Tumlison and Douglas 1992) (Prey. *Plecotus)*
Evening bat	*Nycteceius humeralis* (Rafinesque 1819)

Appendix B. Species Accounts

Species accounts are based on research conducted in South Dakota, if available, and research conducted elsewhere. Species accounts include information pertaining to appearance, distribution and status, natural history, subspecies, and management notes concerning individual species found in South Dakota. Management notes are of great importance and each species is categorized under multi-habitat, cave-roosting, or tree-roosting bats. Multi-habitat bats roost in a variety of areas: trees, caves, mines, crevices, and buildings. Tree-roosting bats roost exclusively in trees, while cave-roosting bats roost nearly always in caves (or mines).

Tree-Roosting Bats

Eastern red bat *(Lasiurus borealis)*

Museum Records (4): BONHOMME County: I (KU); BROOKINGS County: I (SDSU); HANSEN County: 1 (SDSU); HUGHES County: I (TTU); MCCOOK County: 1 (SDSU); MINNEHAHA County: 1 (SDSU); PENNINGTON County: 2 (KU).

Appearance

Red bats *(Lasiurus borealis)* are medium-sized bats with average weight 11.03 g and forearm length 36.88 mm (Swier 2003). Generally, red bats are near 12 cm (5 in) in length (Over and Churchill 1945). Red bats are rusty yellow or reddish-orange with long, dense fur extending to the uropatagium. A small, distinct tail and long, pointed wings characterize red bats. Ears are short and rounded with little to no hair evident. Indistinct white hairs lay along the back and belly depending on the sex. Typically, males have bright orange fur, and females have frost-tipped orange fur (Nowak and Paradiso 1983).

Distribution and Status

Red bats range in the United States from east of the Rocky Mountains to the Atlantic coast, excluding the Florida peninsula (Nowak and Paradiso 1983); red bats are common throughout the United States. In South Dakota, red bats are found throughout the state except in the treeless areas (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000); red bats are least common in the Black Hills (Tigner and Dowd Stukel 2003). Population dynamics in the Black Hills are relatively unknown due to limited observations (5) and summer residency (Tigner and Dowd Stukel 2003). Shump and Shump (1982a) reported that red bats are probably found in areas of the Great Plains with adequate tree cover. This common migratory species was observed in Clay County in April and primarily used timbered areas (Findley 1956).

Natural History

Red bats are solitary tree roosting bats. If females have young, then mothers can be seen roosting with their young; small family groups of four to five bats may be formed during the summer months (Tigner and Dowd Stukel 2003). Deciduous and coniferous trees are considered appropriate tree roosts (Shump and Shump 1982a, Harvey et al. 1999, BCI 2001, TPW 2001). In Kansas, red bats selected tall, large-diameter deciduous trees as day roosts. These were selected within upland areas (Hutchinson and Lacki 2000). In eastern South Dakota, roosting and foraging habitat consists of cottonwood floodplain forest areas, deciduous forest areas, and urban areas (Swier 2003). Red bats roost in foliage of trees and do not depend on cavities for shelter (Barbour and Davis 1969); red bats hang from their roost by one foot disguising themselves as dead leaves or pine cones. Often red bats are seen or heard hunting at early dusk or during cloudy days and can be identified by their acoustic signatures. Feeding occurs in small areas above the tree canopy and beneath streetlights. Flight patterns are distinct; red bats repeatedly fly in large circles or in straight lines above tree canopies (Swier 2003). Primary prey species include beetles, moths, and other night flying insects. Hypothetically, red bats migrate to South Dakota in April and migrate from South Dakota in late August or early September (Swier 2003). In other states, red bats hibernate in tree snags or beneath tree litter during cold winter months, though this has not been documented in South Dakota. Red bats mate in August or September. Because of delayed fertilization, young are not born until late spring. After an 80 to 90-day gestation period, approximately two to four altricial (little to no hair and eyes closed) pups are born each year (Shump and Shump 1982a, Kunz 1982, Harvey et al. 1999, BCI 2001, TPW 2001). In response to increased susceptibility to predation (e.g., blue jays and raptors) due to tree-roosting habits, red bats produce a larger litter size in relation to other bats (Barbour and Davis 1969), which produce one to two pups per year.

Subspecies

Red bat subspecies located in South Dakota is *L. b. borealis.*

Management Notes

Red bats may be impacted by the loss of roost trees. Protecting deciduous and coniferous tree roosts is important to this species. Red bats are dependent on live trees with adequate foliage.

Hoary bat *(Lasiurus cinereus)*

Museum Records (30): BONHOMME County: 3 (KU); BROOKINGS County: 1 (SDSU); BROWN County: 1 (KU); CLAY County 1 (SDSU); CUSTER County: 3 (KU); DAVISON County 1 (FHS); FALL RIVER County: 2 (KU); HAMLIN County: 1 (SDSU); HARDING County: 1 (KU); HYDE County: 1 (SDSU); LAKE County: 1 (SDADR - rabies positive); LAWRENCE County: 15 (KU); MINNEHAHA County: 4 (SDSU); PENNINGTON County: 4 (KU); UNKNOWN County-Moreau River: I (USNM).

Appearance

Hoary bats *(Lasiurus cinereus)* are the largest bats found in South Dakota (Over and Churchill 1945, Turner 1974). Hoary bats can be easily recognized by their large size (Shump and Shump 1982b, Nowak and Paradiso 1983, Harvey et al. 1999); average forearm length measures 55.00 mm and average weight measures 32.5 g (Swier 2003). Generally, hoary bats are greater than 12 cm (5 in) long (Over and Churchill 1945). Hoary bat fur is a combination of black and brown with white "frosting" on the tips. Hoary bats have dark wing membranes, furred uropatagiums, large teeth, and short, round, black-edged ears.

Distribution and Status

Hoary bats are found in the 48 contiguous United States and Hawaii (Nowak and Paradiso 1983). Shump and Shump (1982b) reported that hoary bats, among North American bats, are the most widespread bats though they are never found in great densities. In South Dakota, the hoary bat ranges throughout the state (Over and Churchill 1945, Jones and Genoways *1967*, Jones et al. 1985, Higgins et al. 2000, BCI 2001). Hoary bats are relatively common throughout the Great Plains (Shump and Shump 1982b). In Clay County, the migratory hoary bat was found less commonly than the red bat, although this bat selected the same habitat as red bats (Findley 1956). In the Black Hills, hoary bats are plentiful where suitable habitat is available (Turner 1974, Mattson 1994).

Natural History

Being a solitary, tree roosting bat, hoary bats will cryptically roost in trees with adequate foliage cover above but minimal foliage cover below. Roost sites are maintained on edge trees with heights of 3 to 5 m (3.3 to 5.5 yds). In eastern South Dakota, hoary bats select trees in cottonwood floodplain forests along the Missouri River, but hoary bats also have been located using trees in urban areas (Swier 2003). Generally, hoary bats are found near water. Foraging periods begin after dark and persist until one hour before sunrise. Hoary bats can move up to 39 km (24 mi.) in one night due to fast, straight flight patterns. Being powerful fliers due to their large size, hoary bats are capable of flight from a level surface. Hoary bats are easy to detect by calls. They produce forceful calls while in flight and emit low frequency

(16 to 18 kHz) calls while not feeding. Foraging occurs over water sources or at treetop levels above the tree canopy. Typical prey consists primarily of moths and supplemented by beetles and mosquitoes (Black 1974, van Zyll de Jong 1985). In the Black Hills, most hoary bats are captured between early June and late August (Tigner and Dowd Stukel 2003). Hoary bats in South Dakota migrate south during cold winter months. Females precede males in the migration north; females seem to inhabit the plains or arid flats during warm months, whereas males inhabit higher altitudes or latitudes (Turner 1974). Generally, hoary bats mate in the late summer or the early fall. Fertilization occurs the following spring, and parturition occurs before mid-June (van Zyll de Jong 1985). Approximately two young are produced each year (Harvey et al. *1999,* BCI 2001, TPW 2001). Females are often susceptible to severe windstorms, especially when carrying young.

Subspecies

Subspecies of hoary bat found in South Dakota is *L. c. cinereus.*

Management Notes

Hoary bats may be susceptible to the loss of selected tree roosts. Protecting deciduous and coniferous tree roosts is important to this species. Hoary bats are dependent on live trees at least 3 m tall with adequate foliage cover for roost sites. Typically, hoary bats select trees on the edges of forest areas.

Silver-haired bat *(Lasionycteris noctivagans)*

Museum Records (12): CUSTER County: 1 (KU); DAY County: 1 (USNM); FALL RIVER County: 3 (KU); HARDING County: I (KU); KINGSBURY County: 1 (SDSU); LAWRENCE County: 3 (KU); PENNINGTON County: 3 (KU).

Appearance

Silver-haired bats *(Lasionycteris noctivagans)* are medium-sized bats, which are noticeably smaller than hoary bats. Average forearm length measures 41.30 mm and average weight measures 12.31 g (Tigner and Dowd Stukel 2003). Silver-haired bats measure slightly over 10 cm (4 in) in length (Over and Churchill 1945). This bat has long, soft brown to black fur, which is silver-tipped across the body. Ears are hairless and round with blunt, rounded traguses; ears are nearly as wide as long. Fur continues onto uropatagium, and ears and wing membranes are black.

Distribution and Status

Silver-haired bats range throughout forested regions of the 48 contiguous states in the United States, excluding Florida (Nowak and Paradiso 1983). Silver-haired bats are erratically distributed and relatively uncommon throughout their range (Kunz 1982, BCI 2001). In South Dakota, silver-haired bats are found sporadically throughout the state (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Silver-haired bats are found in the northern and southern Black Hills, though silver-haired bats are more prominent in the southern Black Hills (Tigner and Dowd Stukel 2003). Seemingly, silver-haired bats migrate through the Black Hills region, although it is possible that a few silver-haired bats remain in the Black Hills throughout the year (Turner 1974, Tigner and Dowd Stukel 2003). In addition, Swier (2003) found silver-haired bats in northeastern South Dakota. Silver-haired

bats are considered a South Dakota species of concern due to its rarity or limited range (SDGFP 2002).

Natural History

Silver-haired bats are one of the slowest moving bats in North America (Harvey et al. 1999). Typically, silver-haired bats roost under bark, in snags, and in tree cavities or crevices (Mattson et al. 1996). More specifically, males roost solitarily beneath bark or in cracks/crevices on boles of trees at varying heights. Males change roosts frequently (e.g., daily), and roost inhabitance averages eight days (Mattson 1994). This bat species depends on old growth forests, generally coniferous forests, with diverse tree structure and ample snags, but silver-haired bats are also found in wooded areas along streams or rivers (Nowak and Paradiso 1983, Mattson et al. 1996). In eastern South Dakota, silver-haired bats inhabit cottonwood riparian forests and other deciduous forests (Swier 2003). Corridors, such as roads and water sources, accumulate prey and allow maneuverable flight by bats. This results in use of these areas for foraging. Silver-haired bats are opportunistic feeders; foraging occurs at seven meters or less above ground and includes prey such as termites, true bugs, moths, beetles, and mosquitoes (Kunz 1982, Whitaker et al. 1981 a). Often silver-haired bats drink over woodland ponds prior to sunset. Kunz (1973) stated that silver-haired bats in Iowa display a bimodal activity pattern, appearing two hours after sunset for approximately two hours and two hours before sunrise for approximately two hours. Silver-haired bats migrate south during late summer or early fall with females moving farther south than males (Kunz 1982). Hibernacula include (beneath) bark, snags, open buildings, or underground structures, though the use of underground structures is not documented in South Dakota. Turner (1974) indicated that some individuals might winter in the Black Hills, but most silver-haired bats migrate south with the onset of cold weather. Most silver-haired bats are captured from June to September (Tigner and Dowd Stukel 2003). Each year silver-haired bats produce one to two pups, most commonly twins, in late spring or early summer after 50 to 60 days of gestation (Kunz 1982). Pups are raised in maternity roosts, and like most tree-roosting bats silver-haired bats often switch maternity roosts during the maternity season (Kunz 1982, Harvey et al. 1999, BCI 2001, TPW 2001). Maternity roosts were identified in ponderosa pine snags an average 10 m off the ground ranging from 6 to 55 individuals in the roosts (Mattson 1994). More specifically, maternity roosts were found in old woodpecker cavities of large (38 to 62 dbh) snags with unrestricted southern exposure (Betts 1996, Mattson 1994, Vonhof 1996).

Subspecies

No subspecies are recognized for the silver-haired bat (Jones and Genoways 1967, Kunz 1982, Wilson and Ruff 1999, NSE 2002).

Management Notes

Silver-haired bats are susceptible to forest habitat alterations. This bat is reliant on live and dead trees and selects a range of trees with diverse age structure. Snags are particularly important for the survival of young bats. Reductions in snag numbers will lead to less roosting opportunities and more competition among snag roosting species. Forest management practices (e.g., silviculture) must retain large snags through time to maintain this species (Tigner and Dowd Stukel 2003).

Multi-Habitat Bats

Northern myotis *(Myotis septentrionalis,* formerly known as *Myotis keeni* in South Dakota)

Museum records (23): BONHOMME County: 4 (KU); HUGHES County: 2 (TTU); PENNINGTON County: 17 (KU); STANLEY County: 1 (USNM).

Appearance

Northern myotis *(Myotis septentrionalis)* are rather small bats with average forearm length measuring 36.07 mm and average weight measuring 7.13 g (Tigner and Dowd Stukel 2003). Body lengths may reach 10 cm (4 in) (Fitch and Shump 1979), and overall ear lengths average 16.4 mm (Tigner and Dowd Stukel 2003). Northern myotis have similar light to dark brown fur as little brown myotis with dark backs and light bellies (Fitch and Shump 1979). Membranes and ears are dark brown. In addition, northern myotis have buffy shoulder patches and long, mouse-like ears. Northern myotis can be distinguished by ear length and tragus shape; traguses are long and narrow with pointed tips. Also, face masks, though similarly dark brown, are balder than comparable *Myotis* species.

Distribution and Status

In the United States, northern myotis range in forested regions from east to central and south to northern Florida (Nowak and Paradiso 1983). Northern myotis are common throughout their range, though they are found less commonly than little brown myotis (Fitch and Shump 1979). In South Dakota, northern myotis are found rather uncommonly throughout the state (Jones and Genoways 1967, Higgins et al. 2000). Conversely, northern myotis are rather abundant throughout the Black Hills, and few winter occurrences have been recorded (Tigner and Dowd Stukel 2003). Northern myotis are state species of concern due to their rarity and limited range (SDGFP 2002).

Natural History

The northern myotis is an aggressive species when handled. Typically, these bats bite and vocalize as defensive mechanisms, especially when captured. Northern myotis select roosts in tight crevices or holes sheltered from normal airflow. Often day roosts are selected in open buildings, under bark, or under house shutters, and night roosts or winter hibernacula comprise caves or mines. Northern myotis are dependent on night roosts, and hibernacula are selected in areas with standing water and high humidity (90%) (Tigner and Dowd Stukel 2003). Northern myotis may roost solitarily or in clusters of up to 100 bats, though clusters usually do not grow beyond 100 bats. In eastern South Dakota, northern myotis selected cottonwood floodplain forests or deciduous forests along the Missouri River (Swier 2003). In these areas, northern myotis probably selected trees as roost sites. Generally, northern myotis are found near water sources and dense forests. Foraging takes place over forested hillsides and ridges with prey consisting of night-flying insects. Northern myotis are food generalists (Nagorsen and Brighman 1993, van Zyll de Jong 1985). Northern myotis mate in late summer or early fall. In late spring or early summer, one young is born with minimal hair and closed eyes. Upon the arrival of the newborn pups, a small nursery colony is formed by females (Harvey et al. 1999, BCI 2001, TPW 2001). Tigner and Aney (1993) reported one maternity roost in an attic of a two-story brick building along the edge of the Black Hills.

Subspecies

No subspecies are recognized for the northern myotis (Wilson and Ruff 1999, NSE 2002).

Management Notes

Northern myotis are vulnerable to threats associated with humans. Because northern myotis have an affinity towards buildings as maternity roosts, public awareness of maternity roosts is particularly important with protecting this bat (Tigner and Dowd Stukel 2003). Also, this bat species is dependent on live trees, dead trees (e.g., snags), caves, and mines, which requires protection of these roost sites as well.

Little brown myotis *(Myotis lucifugus)*

Museum records (84): CUSTER County: 14 (KU), 8 (TTU), 2 (WCNP); FALL RIVER County: 1 (KU); GREGORY County: 1 (USNM); HARDING County: 27 (KU); LAWRENCE County: 16 (KU); MEADE County: 1 (KU); MINNEHAHA County: 1 (SDSU); PENNINGTON County: 12 (KU), 1 (TTU); STANLEY County: 1 (USNM); UNION County: 1 (KU); WALWORTH County: 2 (SDSU).

Appearance

Little brown myotis *(Myotis lucifugus)* are relatively small bats with average forearm length 37.49 mm and average weight 8.33 g (Tigner and Dowd Stukel 2003). Body length measures nearly 10 cm (4 in) (Over and Churchill 1945). Pelage coloration is similar to northern myotis, appearing light to dark brown. More specifically, fur appears glossy along the back and buffy along the belly. Wing and ear membranes are dark brown. Little brown myotis have shorter ears than northern myotis; their ears do not extend past nose tip when pressed forward (Tigner and Dowd Stukel 2003). Calcars are not keeled and traguses are blunt and measuring one half the length of the ears.

Distribution and Status

Little brown myotis range throughout the United States stretching north into Alaska, excluding the south-central United States (Nowak and Paradiso 1983). Throughout their range, little brown myotis are common and can exploit many habitats. Little brown myotis are found commonly throughout South Dakota, except in the extreme south central portion of the state (Jones et al. 1985, Higgins et al. 2000). In the Black Hills, little brown myotis are abundant (Turner 1974, Tigner and Dowd Stukel 2003). Little brown myotis are relatively common near urban areas.

Natural History

Forested areas (e.g., riparian areas) and mountainous forests are favored by little brown myotis, although they may be found near or among structures as well. Fenton and Barclay (1980) consider little brown myotis opportunistic species with reference to foraging habitat and roost selection. Generally, habitat in eastern South Dakota consists of cottonwood forests, deciduous forests, and urban areas (Swier 2003). Roost sites appear in buildings, trees, caves, and mines. Little brown myotis are associated with humans, more specifically human-made structures (e.g., houses) (Fenton and Barclay 1980). Often males roost (singly or colonially) separate from females during the summer. Day roosts usually are located in dimly lit areas (Fenton and Barclay 1980). Night roosts provide areas for bats to congregate

after feeding. At night roosts, males are usually found in the spring and early summer, while females are usually found in the late summer and early fall (Tigner and Dowd Stukel 2003). Little brown myotis hibernate in high humidity and temperature sites (Fenton and Barclay 1980), where noticeable droplets of condensation form on their bodies (Tigner and Dowd Stukel 2003). Limited roost entrance size is tolerated by little brown myotis. Usually little brown myotis forage over short distances above large bodies of water (Swier 2003) or infrequently terrestrial areas near roost sites. While foraging, little brown myotis fly low with slow wing beats. They primarily capture aquatic insects; little brown myotis prey consists largely of aquatic insects, although terrestrial insects, such as beetles and moths, may supplement their diet (Fenton and Barclay 1980, Harvey et al. 1999, BCI 2001). Individuals mate in autumn, prior to or during hibernation. One pup per year is born in late spring or early summer after a 50 to 60 day gestation (Fenton and Barclay 1980, Harvey et al. 1999, BCI 2001). At approximately three weeks, pups become volant. Females with pups form large nursing colonies in man-made structures, such as buildings and attics (van Zyll de Jong 1985). Trees may also serve as nursery roosts (Fenton and Barclay 1980). In the Black Hills, all identified maternity roosts are in buildings (Tigner and Dowd Stukel 2003).

Subspecies

The two subspecies found in South Dakota include *M. 1. carissima* and *M 1. lucifugus*. *M 1. carissima* is paler with slightly larger cranial dimensions than *M 1. lucifugus* (Jones and Genoways 1967).

Management Notes

Because little brown myotis may select man-made structures for roosting, maternity and nursery roosts may be threatened more than roosts of bats choosing natural roosts (Tigner and Dowd Stukel 2003). By increasing awareness towards bats, human-related threats associated with bats may be reduced. Also, little brown myotis select certain hibernacula; it is imperative to protect these roosts.

Western small-footed myotis *(Myotis ciliolabrum*, formerly *Myotis leibii)*

Museum Records (108): CUSTER County: 15 (KU), 5 (USNM), 2 (UCB); FALL RIVER County: 5 (KU); HARDING County: 8 (KU); HUGHES County: I (TTU); JACKSON County: 27 (KU); LAWRENCE County: 5 (KU); PENNINGTON County: 40 (KU).

Appearance

Western small-footed myotis *(Myotis ciliolabrum)* are small bats with average forearm length measuring 31.27 mm and average weight measuring 5.72 g (Tigner and Dowd Stukel 2003). Their bodies can reach total lengths near 10 cm (4 in) (Over and Churchill 1945). In the Black Hills, western small-footed myotis are considered the smallest bats (Tigner and Dowd Stukel 2003). As their name implies, western small-footed myotis have small feet with average lengths of 6.5 mm (van Zyll de Jong 1985). Western small-footed myotis have cream-colored fur accented by black masks, ears, and membranes. Membranes are usually hairless. Calcars are keeled, skull appear flattened, ears are long, and traguses are narrow. Traguses measure one half the total ear length (Tigner and Dowd Stukel 2003).

Distribution and Status

Western small-footed myotis range in the western portion of the United States (Nowak and Paradiso 1983). This species is relatively uncommon throughout its range in the United States. As a result, western small-footed myotis are species of concern throughout the nation (Harvey et al. 1999). In South Dakota, western small-footed myotis are found in the western portion of the state (Jones and Genoways 1967, Higgins et al. 2000). According to Over and Churchill (1945), western small-footed myotis are uncommon in western South Dakota. Western small-footed myotis were present year-round in the five counties comprising the Black Hills, although populations were relatively small (Turner 1974, Tigner and Dowd Stukel 2003). *M ciliolabrum* has been documented in Hughes County in central South Dakota as indicated by museum specimens.

Natural History

Western small-footed myotis are located in arid habitats with cliffs, talus fields, and prairies containing clay buttes and steep banks along rivers. Stebler (1939) reported that western small-footed myotis were found in western South Dakota near floodplain areas with cottonwood-willow associations. Typically, roost sites frequented by small-footed myotis include crevices and spaces beneath rock or clay areas, which are often found near water sources. Because of their small size and agile flying ablilty, western small-footed myotis are able to use small roost entrances. In the Black Hills, western small-footed myotis were discovered roosting in caves and mines (Tigner and Dowd Stukel 2003). Hibernacula include cool and dry caves or mines where western small-footed myotis roost in crevices, on walls, or off ceilings. Western small-footed myotis hibernate individually with minimal movement (Tigner and Dowd Stukel 2003). Foraging begins after dusk with peak foraging hours from 2200 h (10 PM) to 2300 h (11 PM) and from 0100 h (1 am) to 0200 h (2am) (Harvey et al. 1999). Western small-footed myotis have slow, erratic flight patterns with very rapid echolocation calls while searching for food (prey). These bats are strong fliers that can obtain flight from level surfaces. Foraging occurs 1 to 3 m (1.1 to 3.3 yd) above ground over cliffs or clay buttes. Prey consists of small insects, such as flies, beetles, and moths (van Zyll de Jong 1985). Western small-footed myotis use hibernacula, such as caves and/or mines. Each year one pup or twin pups are born in late spring or early summer. Females care for young alone or may gather in a small group. No nursery or maternity roosts have been discovered in the Black Hills, though rocky outcrops and crevices throughout the Black Hills offer areas as summer roosts; nursery roosts were discovered in cracks and crevices of clay-volcanic ash areas of the Badlands (Tigner and Dowd Stukel 2003). Minimal data are available on western small-footed myotis (BCI 2001, TPW 2001).

Subspecies

Subspecies of western small-footed myotis found in South Dakota is *M c. ciliolabrum*.

Management Notes

The main threat to this bat is availability of suitable hibernacula. As a result, identifying and protecting sites (or roosts) that offer suitable habitat for western small-footed myotis is important (Tigner and Dowd Stukel 2003). Because little is known regarding various aspects of western small-footed myotis, further research is needed particularly on maternity and nursery roosts in South Dakota.

Fringed myotis *(Myotis thysanodes)*
Museum Records (13): CUSTER County: 5 (KU), 1 (UM); FALL RIVER County: 1 (KU); JACKSON County: 2 (KU); PENNINGTON County: 4 (KU).

Appearance

Fringed myotis *(Myotis thysanodes)* are medium-sized bats with average length 40.82 mm and average weight 7.8 g (Tigner and Dowd Stukel 2003). Body length measures approximately 10 cm (4 in) (Harvey et al. 1999). Appearing similar to long-eared myotis (M *evotis),* fringed myotis are classified as long-eared myotis with darkly colored fur minus a golden tinge. Ears are longer than other *Myotis* species, besides long-eared myotis, and measure less than half forearm length (van Zyll de Jong 1985). Long fur covers their back appearing darker than their belly fur. Ears and membranes are dark to black, and noticeable, stiff hairs are present down the free edge of the uropatagium.

Distribution and Status

Fringed myotis can be found in the United States from the Pacific Coast to the Black Hills of South Dakota and Wyoming (Nowak and Paradiso 1983). Throughout their range, fringed myotis are located sporadically resulting in the designation as a national species of special concern, according to Bat Conservation International (Harvey et al. 1999). In South Dakota, fringed myotis form a disjunct population in the Black Hills and possibly other western regions (Jones and Genoways 1967, Jones and Choate 1978, O'Farrell and Studier 1980, Jones et al. 1985, van Zyll de Jong 1985, Higgins et al. 2000). Turner (1974) stated that Black Hills fringe-tailed myotis were found in Pennington, Custer, and Fall River counties throughout the year. Due to their rarity or limited range in South Dakota, Black Hills fringe-tailed myotis are listed as a state species of concern (SDGFP 2002).

Natural History

Various habitats ranging from desert shrub to pine associations at moderate elevations are used by fringed myotis (O'Farrell and Studier 1980, Harvey et al. 1999, BCI 2001, TPW 2001). Fringed myotis use roost sites that consist of caves or mines and abandoned buildings. Typically, fringed myotis are found roosting in caves, natural rock crevices, and buildings (Tigner and Dowd Stukel 2003). Because these bats hibernate during the winter, they are considered year-round residents. Often hibernating individuals are difficult to locate and identify due to selection of cracks of crevices in mines or caves (Tigner and Dowd Stukel 2003). Usually males roost individually in rock crevices and females roost collectively forming small nursery colonies (average 18.9 individuals) (Cryan and Bogan 1996). O'Farrell and Studier (1980) reported that roost sites were usually in open areas where the fringed myotis could form tightly packed clusters of bats. Fringed myotis have characteristically deliberate and highly maneuverable flight while foraging. Foraging occurs over vegetative canopy from sunset until midnight with prey consisting of principally beetles but also moths (Black 1974). To survive the winter, fringed myotis form hibernacula colonies in typical roost sites (e.g., caves or mines) (Harvey et al. 1999, BCI 2001, TPW 2001). Fringed myotis mate in late summer or early fall prior to hibernation. In late spring or early summer, one pup is born each year after a 50 to 60-day gestation period (O'Farrell and Studier 1980). Large nursery colonies are formed upon the arrival of the pups. Adults typically roost separately

from the nursery colonies. Adults fly to nursery roosts to feed their young returning to their roost after feeding (Harvey et al. 1999, BCI 2001, TPW 2001).

Subspecies

Subspecies is the Black Hills fringe-tailed myotis, *M. t. pahasapensis*, which is briefly mentioned above.

Management Notes

Fringed mytois are reliant on caves or mines and abandoned buildings as roost sites. Captures are locally abundant indicative of unique or significant bat habitats (Tigner and Dowd Stukel 2003). These habitats should be recognized. Furthermore, information is required with regard to maternity and nursery roosts, relocation habits, and hibernacula requirements and availability.

Long-eared myotis *(Myotis evotis)*

Museum Records (20): HARDING County: 20 (KU).

Appearance

Long-eared myotis *(Myotis evotis)* are medium-sized bats weighing on average 7.5 g and forearm measuring on average 38.17 mm (Tigner and Dowd Stukel 2003). Body length measures approximately 9 cm (3.5 in) (Over and Churchill 1945). Long-eared myotis have pale yellow to light brown, glossy fur with dark brown shoulder patches. Ears and membranes are black. Long-eared myotis have ears that average longer than the ears of other American members of the genus *Myotis* (Manning and Jones 1989). Therefore, long-eared myotis appear similar to the Black Hills fringe-tailed myotis though hairs edging the uropatagium are indistinct and ears are much larger in long-eared myotis (van Zyll de Jong 1985). Ears extend 5 mm beyond their nose tip; overall ear lengths are greater than one half the forearm length.

Distribution and Status

Long-eared myotis range from the Pacific Coast to the extreme western Dakotas of the United States, typically in temperate areas (Nowak and Paradiso 1983, Manning and Jones 1989). Nationally, this species is of special concern (Harvey et al. 1999). In South Dakota, long-eared myotis are found in the Black Hills and the northwestern region (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). No winter roosts have been identified in the Black Hills (Tigner and Dowd Stukel 2003), though one specimen has been found in Harding County (northwestern SD) (Anderson and Jones 1971, Jones and Choate 1978). Because of their rarity or limited range in South Dakota, long-eared myotis are considered species of concern (SDGFP 2002).

Natural History

Long-eared myotis use coniferous forests at higher elevations or and badlands of the Great Plains. Stebler (1939) reported that long-eared myotis were found near streams in the Black Hills bordered by bur oak associations. Generally, long-eared myotis are found in a variety of habitats though most habitats are associated with forest areas (Manning and Jones 1989, Nagorsen and Brigham 1993). Roost sites include live or dead trees (beneath bark), abandoned buildings, mines or caves, sinkholes, or cliff fissures. Night roosts consist of caves

or mines and nursery roosts usually occur in buildings (Tigner and Dowd Stukel 2003). Winter hibernacula include primarily caves or mines. Long-eared myotis have a slow maneuverable flight, which aids in foraging abilities. Foraging begins after dusk or well past dark over tree canopy, ponds, or streams. Beetles and moths comprise most of their diet (Black 1974). Breeding occurs in late summer or early fall before hibernation. One pup is produced each year in early to late summer. Once pups are born, long-eared myotis form maternity colonies on the ground in rock cervices, fallen logs, or other ground dwelling sources (Manning and Jones 1989, Harvey et al. 1999, BCI 2001, TPW 2001). Maternity colonies are relatively small, usually less than 30 individuals.

Subspecies

Subspecies found in South Dakota is *M e. evotis.*

Management Notes

Little is known concerning long-eared myotis in South Dakota, particularly the Black Hills. Further information is required to properly protect this species (Tigner and Dowd Stukel 2003).

Long-legged myotis *(Myotis volans)*

Museum Records (103): CUSTER County: 20 (KU), 2 (UM), I (UCB); FALL RIVER County: 3 (KU); HARDING County: 43 (KU); LAWRENCE County: 12 (KU); MEADE County: 1 (KU); PENNINGTON County: 21 (KU).

Appearance

Long-legged myotis *(Myotis volans)* are medium-sized bats with average forearm length 37.93 mm and average body weight 7.84 g (Tigner and Dowd Stukel 2003). Characteristics of long-legged myotis include dull brown fur, small hindfeet, and short, rounded ears (Warner and Czaplewski 1984, Harvey et al. 1999). Ears and membranes are dark brown. In addition, long-legged myotis have long hair along the underside of the wing membrane, short rostrums, and steep foreheads (van Zyll de Jong 1985). Typically, females are larger than males, which is shown in forearm length. Often it is difficult to distinguish long-legged myotis from little brown myotis, especially during hibernation. Long-legged myotis have more dense fur along the ventral surface of their wing membranes and distinct keels. (Fur and keels are usually lacking in little brown myotis.)

Distribution and Status

Much like long-eared myotis, long-legged myotis range from the Pacific Coast to the extreme western Dakotas (Nowak and Paradiso 1983). This species is of special concern nationwide (Harvey et al. 1999). In South Dakota, long-legged myotis are found in the Black Hills and other western portions of the state (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Long-legged myotis are more commonly found in the Black Hills and are year-round residents (Tigner and Dowd Stukel 2003). Moreover, two studies indicate that long-legged myotis are the most common bat in Black Hills (Turner 1974, Mattson and Bogan 1993). Turner (1974) states all Chiropteran species found in the Black Hills are associated with long-legged myotis.

Natural History

Habitat of long-legged myotis consists of coniferous juniper forest mountain regions at moderate elevations, although this bat may use lowlands or riparian areas (Warner and Czaplewski 1984). Barbour and Davis (1969) noted that long-legged myotis are closely associated with coniferous forests. Sometimes selected habitat areas can be relatively arid. Long-legged myotis use trees (under bark or in cavities), caves, mines, and rock crevices for roost sites in the Black Hills (Tigner and Aney 1994, Cryan and Bogan 1996). Selected hibernacula include abandoned mines and caves and are very humid (approximately 90%). During hibernation, droplets of condensation usually accumulate on the body while suspended from the ceiling or wall (Tigner and Dowd Stukel 2003). Foraging occurs after twilight for 3 to 4 hours throughout canopy, much like the long-eared myotis (Barbour and Davis 1969). Prey species include chiefly moths but also other soft-bodied insects (Whitaker et al. 1981 b). One pup is usually born each year in July (Warner and Czaplewski 1984, Harvey et al. 1999, BCI 2001, TPW 2001). Males roost separately from females, while females roost communally in maternity roosts. Most maternity roosts are located in tree cavities (van Zyll de Jong 1985), but lactating females were discovered roosting beneath the bark of snags (dbh z 66 cm) in the Black Hills (Cryan and Bogan 1996).

Subspecies

M v. interior is the subspecies of long-legged myotis found in South Dakota.

Management Notes

Long-legged myotis require dead (e.g., snags) and live trees and caves or mines. To develop conservation strategies for this bat, habitat requirements of long-legged myotis need to be identified. More specifically, further information is required regarding maternity and nursery roosts (Tigner and Dowd Stukel 2003). Reproductive females were absent from foraging areas implying that roost sites with important characteristics might be present in the Black Hills (Cryan and Bogan 1996). Concentrations of bats at specific roost sites create greater susceptibility among bats to habitat alterations (Tigner and Dowd Stukel 2003).

Big brown bat (Eptesicus fuscus)

Museum Records (180): BEADLE County: 1 (SDSU); BON HOMME County: 30 (KU); BROOKINGS County: 5 (SDSU); BRULE County: 2 (SDSU); CHARLES MIX County: 1 (SDSU); CLAY County: 8 (KU), 2 (SDSU), 2 (USNM); CUSTER County: 17 (UM), 5 (KU), 4 (USNM), 2 (WCNP); DAVISON County 2 (SDSU); DEUEL County: 1 (SDSU); FALL RIVER County: 22 (KU); GRANT County: 1 (SDSU); HARDING County: 11 (KU); HUGHES County: 1 (SDSU), 8 (TTU); HUTCHINSON County: I (SDSU); JACKSON County: 30 (KU); LAKE County: 1 (SDSU); LAWRENCE County: 31 (KU), 5 (USNM); LINCOLN County: 9 (SDSU); MINNEHAHA County: -600 (SDSU); MOODY County: 3 (SDSU); PENNINGTON County: 3 (KU); STANLEY County: 1 (USNM); TURNER County: 3 (SDSU); UNION County: I (KU), 1(SDSU); YANKTON County: 1 (SDSU).

Appearance

Big brown bats *(Eptesicus fuscus)* are large bats with average forearm length 45.72 mm and average body weight 17.54 g (Tigner and Dowd Stukel 2003). Body length measures nearly 13 cm (5 in) (Over and Churchill 1945). Big brown bats have pale brown, long fur,

which varies regionally. Wings are short and broad, and ears are pointed and furred at the medial side of the base. Ears and membranes are black. Big brown bats differ from *Myotis* species; heads and snouts are broader and body size is larger.

Distribution and Status

Big brown bats range throughout the United States with the exception of the extreme south central region and the Florida peninsula (Nowak and Paradiso 1983). Big brown bats are common throughout much of their range. In South Dakota, big brown bats range throughout the state and are very common (Over and Churchill 1945, Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Big brown bats are deemed the most common bat roosting in buildings and are one of the more successful bats residing in the Black Hills (Tigner and Dowd Stukel 2003)

Natural History

Forested areas are selected as primary habitat, although habitat may range from timberline meadows to lowland deserts. Historically, big brown bats selected roost sites in tree cavities or under bark. Stebler (1939) reported that big brown bats were found near floodplain areas of western South Dakota with cottonwood-willow associations. Currently, big brown bats are closely associated with humans because roosts typically occur in man-made structures (Nowak and Paradiso 1983). In Clay County, big brown bats probably day roost in man-made structures (Findley 1956). Over and Churchill (1945) added that big brown bats use day roosts, such as old buildings, rock crevices, and hollow trees. In eastern South Dakota, big brown bats select open areas in urban locales, cottonwood floodplain forests, and deciduous forests but are most abundant in urban areas where they utilize human-made structures (Swier 2003). In the Black Hills, big brown bats roost in buildings, trees, mines, caves, and railway tunnels (Tigner and Dowd Stukel 2003). Big brown bats spend the summer in eastern South Dakota but migrate to western South Dakota for winter hibernation, though some records indicate bats may stay in eastern South Dakota year-round (Swier 2003). Usually summer and winter roosts are in close proximity. Hibernacula microclimates vary due to their large size and high fat reserves (Kurta and Baker 1990). Usually big brown bats hibernate in caves, mines, and buildings (Tigner and Dowd Stukel 2003). (Big brown bats are the only species to hibernate in buildings in Black Hills [Tigner and Dowd Stukel 2003].) Hibernating colonies usually consist of females and males with more males than females present (Nowak and Paradiso 1983). Feeding occurs throughout the night with peak activity at dusk and just prior to sunrise (Kurta and Baker 1990). Big brown bats emerge with steady, straight flight patterns to feed over meadows, canopy vegetation, or water at nearly six to ten meters above ground (Nowak and Paradiso 1983). These bats are not as acrobatic and evasive as *Myotis* species in flight and must be at an elevated perch to initiate flight (Tigner and Dowd Stukel 2003). Big brown bats primarily prey on beetles, although many other insect species may comprise their diet. Mating occurs in the fall or winter before hibernation. One to two (twin) young are born each year in June after a 60-day gestation. Big brown bats form maternity roost sites of many individuals usually in man-made structures, but historically they roosted under tree bark and in tree cavities (Kurta and Baker 1990, Harvey et al. 1999, BCI 2001, TPW 2001). Brigham (1991) located maternity roosts in snags. Big brown bats select maternity roosts in older buildings with high temperatures, a great deal of access areas, and

wide temperatures gradients (Williams and Brittingham 1997), and large maternity roosts are not uncommon (Tigner and Dowd Stukel 2003).

Subspecies

Two subspecies found in South Dakota include *E. f. fuscus* and *E. f. pallidus.* These two subspecies differ: *E. f. fuscus* have larger craniums and darker pelages than *E. .f pallidus* (Jones and Genoways 1967), and *E. f. fuscus* is found east of the Missouri River, while *E. f. pallidus is* found west of the Missouri River.

Management Notes

Because this bat is associated with humans, the main threat to this bat is lack of public awareness. Therefore, increasing public awareness regarding roost sites and providing information on proper house exclusions is important to protect this bat.

Evening bat *(Nycticeius humeralis)*

Appearance

Evening bats *(Nycticeius humeralis)* are average-sized bats weighing from 7 to 14 g and measuring on average 10 cm (4 in) in body length (Watkins 1972, Harvey et al. 1999). Evening bats have thick, dark membranes and pale brown to reddish brown fur. Generally, the belly is lighter than the back. Ears and tragus (fleshy protrusion in ear) are more rounded than those of *Myotis* spp. This bat resembles a small big brown bat.

Distribution and Status

In the United States, evening bats range from the southeastern Atlantic Coast west to the central region and north to the Midwest (Nowak and Paradiso 1983). Evening bats are uncommon throughout their range, except for the southern coastal states (TPW 2001). Jones and Genoways (1967) noted that evening bats possibly occur in South Dakota, particularly in the southeast, due to the proximity of Nebraska's evening bat population. Evening bats were recently documented in South Dakota. Lane et al. (in press) captured three bats in Vermillion, Clay County; two bats were captured in 2000 and one bat was captured in 2001. As a result of these captures, evening bats are considered rare with a limited range in South Dakota (SDGFP 2002).

Natural History

Habitat consists of highly forested areas. Roost sites occur in trees or buildings and almost never caves. The evening bat forages on small nocturnal insects, such as June beetles, and leaves the roost to feed just after dusk foraging well into the night. During late evening foraging bouts, flight is low and steady in search of low-flying insects. The evening bat builds huge fat reserves for a long, southern migration, although much remains unknown about migration routes and hibernation sites (Watkins 1972, Harvey et al. 1999, TPW 2001). Males may not migrate during spring as far north as females (Watkins 1972). In late spring or early fall, young evening bats are born with a litter size consisting of two altricial pups. Pups are produced each year. Large nursery colonies are formed in buildings or attics, whereas small nursery colonies are formed behind loose bark or in tree cavities (Harvey et al. 1999, TPW 2001).

Subspecies

The subspecies of evening bat located in South Dakota is *N. h. humeralis.*

Management Notes

Little is known of evening bats in South Dakota. More data are recommended for proper management.

Cave-Roosting Bats

Townsend's big-eared bat *(Corynorhinus townsendii,* formerly *Plectotus townsendii)*

Museum Records (121): CUSTER County: 41 (KU), 9 (UCB), 8 (USNM); FALL RIVER County: 42 (KU); HARDING County: 3 (KU); JACKSON County: 4 (KU); LAWRENCE County: 1 (KU); MEADE County: 1 (KU); PENNINGTON County: 12 (KU).

Appearance

Townsend's big-eared bats *(Corynorhinus townsendii)* are relatively large bats with average weight 11.59 g and average forearm length 44.31 mm (Tigner and Dowd Stukel 2003). Townsend's big-eared bats measure approximately 10 cm (4 in) body length (Allen 1895, Over and Churchill 1945). Fur is buff along the back and pale buff along the belly (Tigner and Dowd Stukel 2003). Ears are hairless, large, long, and pointed, and measure approximately 2.5 cm (1 in) with long pinnae (Over and Churchill 1945). While roosting, ears are folded back exposing only the tragus. Visible traguses appear as ears of *Myotis* species. Two large bumps exist on the snout. Females are slightly larger than males as demonstrated by forearm lengths (Kunz and Martin 1982).

Distribution and Status

Townsend's big-eared bats range from the Pacific Coast to the extreme western portion of South Dakota (Nowak and Paradiso 1983). Nationally, Townsend's big-eared bats are considered of special concern (Harvey et al. 1999). In South Dakota, Townsend's big-eared bats are located in western portions of the state (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Formerly known as *Plecotus townsendii,* the Townsend's big-eared bat is a cave-dwelling bat distributed throughout the Black Hills (Turner 1974), and they are the most common underground roosting species in this region (Tigner and Dowd Stukel 2003). Due to their rarity and limited range, Townsend's big-eared bats are considered a state species of concern (SDGFP 2002).

Natural History

Habitat consists of arid western desert scrub and pine forest regions, while roost sites occur underground (Harvey et al. 1999, BCI 2001). Townsend's big-eared bats are dependent on underground structures year-round. Roost sites and hibernacula are selected in areas with minimal human intervention and relatively stable, cool temperatures. Selected hibernacula (e.g., mines and caves) are cooler and drier than *Myotis* hibernacula (Tigner and Dowd Stukel 2003). Townsend's big-eared bats hibernate in caves or mines in clusters of several to 100 individuals with a mixture of ages and sexes (Worthington 1992). Disturbance and temperature variation are detrimental to Townsend's big-eared bats; disturbance may cause hibernating clusters to relocate within or leave caves or mines altogether. Townsend's big-

eared bats are agile fliers searching for food in a variety of habitats. In the Black Hills, foraging primarily occurs along forested edges or in the canopy late at night (Kunz and Martin *1982);* Townsend's big-eared bats emerge approxiamtely 30 minutes after sunset (Tigner and Dowd Stukel 2003). Food consists of primarily moths (Pierson et al. *1999).* Townsend's big-eared bats occupy feeding perches in the Black Hills (Tigner and Dowd Stukel 2003). Mating occurs in fall or winter usually in winter roosts. In June of the following year, one pup per year is born after a 50 to 100-day gestation (Pearson et al. *1952).* Young females are reproductively mature and may mate their first fall, whereas males are not reproductively mature until their second year. Females form maternity and nursery roosts in inaccessible, spacious areas in warm sections of underground structures (Tigner and Dowd Stukel 2003), while males continue to roost solitarily (Kunz and Martin *1982,* Harvey et al. *1999,* BCI 2001).

Subspecies

Subspecies of Townsend's big-eared bat found in South Dakota is *C. t. pallescens.*

Management Notes

Townsend's big-eared bats are strictly dependent on underground structures (e.g., caves and mines) and extremely sensitive to disturbance. As a result, protecting caves or mines especially those supplying roosts during critical periods (e.g., maternity or nursery roosts and hibernacula) is necessary to prevent human disturbance and to conserve Townsend's big-eared bats (Tigner and Dowd Stukel 2003). Parallel efforts include increasing public awareness and determining and designating no treatment (where timber harvest does not occur) buffer zones around each protected roost.

Appendix C. Identifying Bats

A key can be used to help identify species. Some mammal species are easily identified without the use of a key, while others are difficult to identify even with the use of a key. Chiroptera is among the more difficult species to identify. Keys help to identify a mammal, in particular bats, to genus and often species. If identification is questionable, do not hesitate to seek assistance from professional mammalogists in the various wildlife agencies and universities.

To use the keys, read the choices in descriptions of the same number and choose the best result. Go to the number that is indicated at the end of the chosen alternative and continue moving through the key until a final choice is indicated. However, a key seldom works for every specimen because each species varies in size, color, and other characteristics. It is best to have several specimens on hand for comparison. Characteristics in these keys apply to only adult animals.

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ORDER CHIROPTERA

Note: Because of the difficulty distinguishing South Dakota's Myotis species, two keys are included in this text. The second key emphasizes measurements obtained from bats found in the Black Hills.

1, Large bat, forearm length usually greater than 50 mm (1.97 in.). Fur is yellowish brown to mahogany and "frosted" with silver; rounded ears edged in black Hay Bat

1. Forearm length usually less than 50 mm (1.97 in.). Fur not as described above Go tot

2. Forearm length usually 41-48 mm (1.61-1.89 in.). Ears large, length greater than 25 mm (0.98 in.)
---------- Tow n send's Big-eared Bat
2. Ears less than 25 mm (0.98 in.) length Qoo 3

3. Large bat, forearm length usually less then 50 mm (1.97 in.) but greater than 41 mm (1.61 in.). Fur is brown, ears less than 20 mm length (0.79 in.), total length greater than 110 mm (4.33 in.); blunt tragus; broad head and snout Biy rown Bat
3. Forearm length usually less than 45 mm (1.77 in.), total length less than 110 mm (4.33 in.) Goto 4

4. Fur black to dark black-brown, "frosted" with silver or white Sirt er-haired Bat
4. Fur not as described above 61® 5

5. Fur bright reddish orange to chestnut, no "frosted" fur Red3 at
5. Fur not as described above Cb® 6

6. Forearm usually less than 34 mm (1.34 in.), black facial mask, ears, and flight membranes contrasting with yellowish-brown to golden-brown fur Western Small-footed Myotis
6. Forearm usually greater then 34 mm (1.34 in.) Gton 7

7. Ears usually 18 mm (0.71 in.) or more in length Gbo 8
7. Ears usually less than 18 mm (0.71 in.) in length Gbo 9

8. Ears usually 22-25 mm (0.87-0.98 in.) in length, ears extend 5 mm (0.2 in.) or more beyond nose tip when laid forward, forearm usually less than 39.5 mm (1.56 in.) but may range from 36-41 mm (1.42-1.61 in.); indistinct fringe of minute hairs along edge of uropatagium Log-eared Myotis
8. Ears usually 18-20 mm (0.71-0.79 in.) in length but may range from 16-20 mm (0.63-0.79 in.), forearm usually more than 39.5 mm (1.56 in.); distinct fringe of small, stiff hairs along the edge of the uropatagium- 1irg e-tailed Myotis

9. Ear length usually 17-18 mm (0.67-0.71 in.) but may range up to 19 mm (0.75 in.); when ear laid forward extending beyond tip of nose (forearm length ranges from 32-39 mm or 1.26-1.54 in.) Northern Myotis
9. Ear length usually less than 16 mm (0.63 in.); when ear laid forward, extending to end of nose but not much past end of nose Crm 10

10 Ears usually 13-15 mm (0.51-0.59 in.), calcar keeled Log-legged Myotis
10. Ears usually 14-15 mm (0.55-0.59 in.), calcar not keeled title Brown Bat (Little Brown Myotis)

ALTERNATE KEY TO ORDER CHIROPTERA
1. Ear length greater than 25 mm (0.98 in) Tow n send's Big-eared Bat
1. Ear length less than 25 mm (0.98 in.) QaD 2

2. Fur extending onto dorsal side of uropatagium; ear shape rounded Gd o 3
2. Sparse or no fur extending onto dorsal side of uropatigium; ear shape pointed Goto 5

3. Forearm length equal to or greater than 45 mm (1.77 in); fur multicolored yellowish and dark gray to black heavily tipped with white; rounded ear edged in black Haay Bat
3. Forearm length equal to or less than 44 mm (1.73 in.) Gbo 4

4. Forearm length 37-44 mm (1.46-1.73 in); dark brown to (usually) black with many hairs silver-tipped; ear round with short, blunt tragus Silver-haired Bat
4. Forearm length 36-42 mm (1.42-1.65 in.); fur color ranges from yellowish-orange to cinnamon; uropatagium is densely furred; tufts of pale fur frequently found at distal end of forearm----Eastern Red Bat

5. Distinct keel on calcar Gm 6
5. Calcar keel absent or weak CTm 7

6. Forearm less than 34 mm (1.34 in.); black mask, ears, and flight membranes contrasting with usually pale brown fur Wd ern Small-footed Myotis
6. Forearm 41-51 mm (1.61-2.01 in.); ears short (less than 20 mm or 0.79 in.), barely reaching nose tip when pressed forward; blunt tragus; broad head and snout BigBrown Bat
6. Forearm 35-41 mm (1.38-1.61 in.); usually furring on ventral side of wing membrane to a line from elbow to knee; fur dull lacking sheen; dark brown ears and flight membranes Long-legged Myotis

7. Ears short (13-15 mm or 0.51-0.59 in.) with blunt tragus approximately ½ length of ear; varying shades of brown often with sheen to fur; forearm 34-41 mm (1.34-1.61 in.); membranes and ears brown ---------- Little Brown Bat
7. Ears long (15-18 mm or 0.59-0.71 in.), extending beyond tip of nose when pressed forward; tragus long and narrow, coming to a point; ears, mask, and flight membranes brown; no fringe of hairs along free edge of uropatagium Northern Myotis
7. Distinct fringe of course hairs along free edge of uropatagium; ear length 16-20 mm (0.63-0.79 in.), ear length generally less than ½ length of forearm; ears extend less than 5 mm (0.2 in.) beyond tip of nose when pressed forward; blackish ears and flight membranes; forearm 39-44 mm (1.54-1.73 in.) ---------- Fringe-tailed Myotis
7. Ear length 22-25 mm (0.87-0.98 in.), ear length generally greater than ½ length of forearm; ears extending more than 5 mm (0.2 in.) beyond tip of nose when pressed forward; frequently displays indistinct fringe of hairs along free edge of uropatigium; ears and membranes blackish; forearm 36-41 mm (1.42-1.61 in.) Long-eared Myotis

Appendix D. Management Recommendations

1. **Underground Roost Habitat**
   - All open underground cavities (e.g., natural caves, abandoned mines) irrespective of size should be evaluated as bat habitat by a qualified bat biologist. No actions that could potentially alter the site and its surrounding area should occur without this evaluation.
   - An acceptable evaluation will consider hibernacula, maternity, and day roost potential therefore surveys must be conducted in the appropriate seasons (e.g., hibernacula surveys cannot be conducted outside of winter months).
   - This will mean that land managers, state biologists, and private landowners will need to plan activities far enough in advance to accommodate evaluation requirements.
   - The (written) evaluation should include a brief description of the site, proposed action, findings, and recommendations or mitigation required for the proposed action to continue.

Note: If the situation warrants a complete closure of the site, other than with a `bat friendly' gate design, then the exclusion must be performed in the season and using methods that would

2. Forearm length usually 41-48 mm (1.61-1.89 in.). Ears large, length greater than 25 mm (0.98 in.)
---------- Tew n send's Big-eared Bat
2. Ears less than 25 mm (0.98 in.) length Qooo 3

3. Large bat, forearm length usually less then 50 mm (1.97 in.) but greater than 41 mm (1.61 in.). Fur is brown, ears less than 20 mm length (0.79 in.), total length greater than 110 mm (4.33 in.); blunt tragus; broad head and snout Big rown Bat
3. Forearm length usually less than 45 mm (1.77 in.), total length less than 110 mm (4.33 in.) Goto 4

4. Fur black to dark black-brown, "frosted" with silver or white Sirt er-haired Bat
4. Fur not as described above GOD 5

5. Fur bright reddish orange to chestnut, no "frosted" fur Red3 at
5. Fur not as described above GOD 6

6. Forearm usually less than 34 mm (1.34 in.), black facial mask, ears, and flight membranes contrasting with yellowish-brown to golden-brown fur Western Small-footed Myotis
6. Forearm usually greater then 34 mm (1.34 in.) Gton 7

7. Ears usually 18 mm (0.71 in.) or more in length Gbo 8
7. Ears usually less than 18 mm (0.71 in.) in length Gbo 9

8. Ears usually 22-25 mm (0.87-0.98 in.) in length, ears extend 5 mm (0.2 in.) or more beyond nose tip when laid forward, forearm usually less than 39.5 mm (1.56 in.) but may range from 36-41 mm (1.42-1.61 in.); indistinct fringe of minute hairs along edge of uropatagium Log-eared Myotis
8. Ears usually 18-20 mm (0.71-0.79 in.) in length but may range from 16-20 mm (0.63-0.79 in.), forearm usually more than 39.5 mm (1.56 in.); distinct fringe of small, stiff hairs along the edge of the uropatagium- 1irg e-tailed Myotis

9. Ear length usually 17-18 mm (0.67-0.71 in.) but may range up to 19 mm (0.75 in.); when ear laid forward extending beyond tip of nose (forearm length ranges from 32-39 mm or 1.26-1.54 in.) Northern Myotis
9. Ear length usually less than 16 mm (0.63 in.); when ear laid forward, extending to end of nose but not much past end of nose (6® 10

10 Ears usually 13-15 mm (0.51-0.59 in.), calcar keeled Log-legged Myotis
10. Ears usually 14-15 mm (0.5 5-0.59 in.), calcar not keeled Little Brown Bat (Little Brown Myotis)

ALTERNATE KEY TO ORDER CHIROPTERA
1. Ear length greater than 25 mm (0.98 in) Tow n send's Big-eared Bat
1. Ear length less than 25 mm (0.98 in.) Ow 2

2. Fur extending onto dorsal side of uropatagium; ear shape rounded Gd o 3
2. Sparse or no fur extending onto dorsal side of uropatigium; ear shape pointed Goto 5

3. Forearm length equal to or greater than 45 mm (1.77 in); fur multicolored yellowish and dark gray to black heavily tipped with white; rounded ear edged in black Hooray Bat
3. Forearm length equal to or less than 44 mm (1.73 in. Gbo 4

4. Forearm length 37-44 mm (1.46-1.73 in); dark brown to (usually) black with many hairs silver-tipped; ear round with short, blunt tragus Silver-haired Bat
4. Forearm length 36-42 mm (1.42-1.65 in.); fur color ranges from yellowish-orange to cinnamon; uropatagium is densely furred; tufts of pale fur frequently found at distal end of forearm----Eastern Red Bat

5. Distinct keel on calcar G® 6
5. Calcar keel absent or weak Gm 7

6. Forearm less than 34 mm (1.34 in.); black mask, ears, and flight membranes contrasting with usually pale brown fur Wd ern Small-footed Myotis
6. Forearm 41-51 mm (1.61-2.01 in.); ears short (less than 20 mm or 0.79 in.), barely reaching nose tip when pressed forward; blunt tragus; broad head and snout BigB rown Bat
6. Forearm 35-41 mm (1.38-1.61 in.); usually furring on ventral side of wing membrane to a line from elbow to knee; fur dull lacking sheen; dark brown ears and flight membranes Long-legged Myotis

7. Ears short (13-15 mm or 0.51-0.59 in.) with blunt tragus approximately ½ length of ear; varying shades of brown often with sheen to fur; forearm 34-41 mm (1.34-1.61 in.); membranes and ears brown ---------- Little Brown Bat
7. Ears long (15-18 nun or 0.59-0.71 in.), extending beyond tip of nose when pressed forward; tragus long and narrow, coming to a point; ears, mask, and flight membranes brown; no fringe of hairs along free edge of uropatagium NA ern Myotis
7. Distinct fringe of course hairs along free edge of uropatagium; ear length 16-20 mm (0.63-0.79 in.), ear length generally less than ½ length of forearm; ears extend less than 5 mm (0.2 in.) beyond tip of nose when pressed forward; blackish ears and flight membranes; forearm 39-44 mm (1.54-1.73 in.) ---------- brig e-tailed Myotis
7. Ear length 22-25 mm (0.87-0.98 in.), ear length generally greater than ½ length of forearm; ears extending more than 5 mm (0.2 in.) beyond tip of nose when pressed forward; frequently displays indistinct fringe of hairs along free edge of uropatigium; ears and membranes blackish; forearm 36-41 mm (1.42-1.61 in.) Long-eared Myotis

Appendix D. Management Recommendations

1. Underground Roost Habitat

- All open underground cavities (e.g., natural caves, abandoned mines) irrespective of size should be evaluated as bat habitat by a qualified bat biologist. No actions that could potentially alter the site and its surrounding area should occur without this evaluation.
- An acceptable evaluation will consider hibernacula, maternity, and day roost potential therefore surveys must be conducted in the appropriate seasons (e.g., hibernacula surveys cannot be conducted outside of winter months).
- This will mean that land managers, state biologists, and private landowners will need to plan activities far enough in advance to accommodate evaluation requirements.
- The (written) evaluation should include a brief description of the site, proposed action, findings, and recommendations or mitigation required for the proposed action to continue.

Note: If the situation warrants a complete closure of the site, other than with a `bat friendly' gate design, then the exclusion must be performed in the season and using methods that would

pose the least adverse affect to the bats. This can be accomplished by biologists and technicians trained in these procedures.

2. Water Source Protection

Depending on location and season springs, seeps, ponds, reservoirs, dugouts, stock tanks may provide important, and often limited, watering or foraging sites for bats. These sites need to be maintained in working order, and free of high levels of feculent material. Heavy levels of livestock congregation (soil compaction) need to be avoided around spring sources. Aquatic and emergent vegetation should be encouraged and maintained. Often these sites were originally created for livestock watering, however these recommendations will benefit livestock water quality and dependability, as well and improving wildlife watering opportunities. It is expected that watering sites located on public lands (National Forests, Grasslands, etc.) will be maintained in this *multiple-use* concept.

3. Riparian/Cottonwood

Riparian, cottonwood, green ash, box elder, or other wooded draw habitats provide critical foraging, roosting, and migration corridors for many bat species and other wildlife. Protect these habitats from activities that may contribute to loss or decline. Improve structural diversity where possible. Encourage that *public land* National Forest/Grassland Management Plans (Standards and Guidelines, Goals and Objectives) be followed.

Note: This is in agreement with the Western Bat Working Group (WBWG) resolution (9/29/2001) that supports the further research, inventory, conservation, maintenance, restoration and re-establishment of historic cottonwood (and sycamore) ecosystems across western North America.

4. Forestry Practices

- Dead Trees (snags) - Many wildlife species utilize snags for habitat but since this is focusing on bats we will limit our discussion. Snags provide roosting habitat, and critical maternity roosts have been found under bark and in old woodpecker cavities. Working towards an average of 8-10 snags per acre would likely provide sufficient roosting habitat for the variety of bats species (Mattson et al. 1994), as well as the customary cavity nesting bird species that depend on this habitat feature.
- Green Trees/Forest Fragmentation - Mature forests provide roost sites for tree bats, and produce insects where bats forage above the canopy. Large diameter, mature green trees provide the replacements for the snags that exist today. Even-aged forestry practices often remove the large diameter trees to make room for the next rotation of young trees. This plan supports un-even aged forestry practices that maintain a mix of old trees while planning for forest regeneration. This can be accomplished on a landscape (watershed) scale and need not necessarily be met at the individual stand level. However, it does need to be monitored and not lost to commodity driven intensive forestry practices. Forest management on public lands is more easily monitored but this multi-storied, un-even aged condition is equally important on state and private forest habitats. Forest fragmentation is a term used to describe breaking-up of large tracts of continuous forests. Due to the naturally fragmented condition of the forests in South Dakota, including the Black Hills it is mentioned only for

reference purposes. Naturally, fragmentation can and does occur on smaller scales. Some principle causes of forest fragmentation are fire, logging and insects (bug killed trees). Man-caused activities should consider any potential to decrease connectivity of forested habitats.

5. Buildings

- If a large number of bats are detected to be roosting in a building (e.g., house) during the summer, please have the site evaluated by a qualified bat biologist. Most likely this site serves as a maternity roost. No actions that could potentially alter this site and its surrounding area should occur without this evaluation.
- This evaluation will help determine the importance of this site and locate any other suitable sites nearby in the event that a proper bat exclusion is conducted.
- For information regarding proper bat exclusions, seek advice from bat biologists, seek information at the SDBWG website (http://nat_hist.sdstate.edu/SDBWG/SDBWG.html, see Help! Bats in My House!), or read Joel Tigner's article "Bats and Buildings" (Appendix G).

Appendix E. Federal Cave Resources Protection Act, 1988 (Public Law 100-691; November 18, 1988, 16 U.S.C. 4301-4309)

Overview. This Act helps protect significant caves on federal lands by identifying their locations, regulating their uses, requiring permits for removal of their resources, and prohibiting destructive acts. Caves must be considered in the preparation and implementation of land management plans and cave locations may be kept confidential.

Findings/Policy. Congress found that significant caves on federal lands are invaluable and irreplaceable parts of our cultural heritage. In some instances, caves are threatened due to improper use, increased recreation, urban sprawl, and lack of specific statutory protection. This Act helps preserve significant caves on federal lands for the perpetual use, enjoyment, and benefit of all people and foster increased cooperation and information exchange between government authorities and people using caves on federal lands for scientific, education, or recreational purposes. U.S. policy states that federal lands should be managed to protect and maintain significant caves to the extent practical. § 4301.

Selected Definitions. Cave: any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the earth's surface or within a cliff or ledge (excluding mines, tunnels and other manmade excavations) and which is large enough to permit an individual to enter. Cave resource: any material or substance occurring naturally in caves on federal lands, such as animal and plant life, paleontological deposits, sediments and minerals. Secretary: Secretary of Agriculture or Secretary of the Interior, as appropriate. § 4302.

Cave Management. Secretary is required to issue regulations to achieve the purposes of the Act no later than August 18, 1989. Regulations must include criteria for identification of significant caves. Secretaries must cooperate and consult with each other in preparing regulations, which should be similar to the extent practical. Secretary must take other actions to further the Act's purposes, which includes identification of significant caves on federal lands, regulation or restriction of use of significant caves as appropriate, entering into volunteer management agreements with people in the scientific and recreational caving community, and appointment of appropriate advisory committees. Secretary must ensure that significant caves are considered in the preparation or implementation of land management plans and foster communication and cooperation among land managers, cave users, and the public. § 4303. Specific locations of significant caves cannot be made available to the public unless the Secretary determines that disclosure of this information would further the Act's purposes and not create a substantial risk of harm, theft, or destruction of caves. Information on significant caves may be made available through written request by federal or state governmental agencies or educational and research institutions. Requests must describe specific sites or areas, explain purposes of seeking information, and include assurances that information will be kept confidential and caves will be protected from vandalism and unauthorized use. § 4304.

Collection Permits. Secretary may issue permits for the collection and removal of cave resources, if proposed activities are consistent with the Act's purposes. Secretary may issue permits for use on Indian lands only if the Indian or Indian tribe owning or having jurisdiction over the land consents. If a permit may result in harm to any religious or cultural site, the Secretary must notify any Indian tribe that may consider the site religiously or culturally important. Upon application of an Indian tribe, the Secretary may delegate to the tribe authority to issue and enforce permits for any cave resource located on the tribe's lands. Permits are not transferable and may be revoked by the Secretary for violation of the Act or failure to comply with the permit's conditions. Actions authorized by permit are not considered violations of the Act. § 4305.
Prohibitions and Penalties.. Act prohibits knowingly destroying, disturbing, defacing, removing, or harming any significant cave; altering free movement of any animal or plant life in or out of a significant cave; entering a significant cave with the intention of committing any prohibited act; possessing, selling, or exchanging any cave resource knowing that the resource was removed from a significant cave on federal lands; and employing or using another person to commit any act prohibited in this section. Violation of these prohibitions is subject to criminal and civil penalties. §§ 4306 and 4307.
Cave Research Program. Secretary of the Interior, acting through the Director of the National Park Service, must establish and administer a cave research program for the orderly and scholarly collection and analyze and disseminate research material on caves in lands managed by the National Park Service. Programs must produce educational information for public understanding of cave geology, assist students and researchers, and provide a comprehensive evaluation of cave resources and protection measures. § 4310.
Related Provision. Notes to this Act contain a related statute, the Lechuguilla Cave Protection Act of 1993. This statute designates approximately 6,280 acres of land in New Mexico as the Lechuguilla Cave Protection Area and protects it from development and mineral exploration. § 4301 note.

BE IT ENACTED BY THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED,

SEC. 1. SHORT TITLE. This Act may be referred to as the "Federal Cave Resources Protection Act of 1988."

SEC. 2. FINDINGS, PURPOSES, AND POLICY.
(a) FINDINGS.-The Congress finds and declares that-
(1) significant caves on Federal lands are an invaluable and irreplaceable part of the Nation's natural heritage; and
(2) in some instances, these significant caves are threatened due to improper use, increased recreational demand, urban spread, and a lack of specific statutory protection.
(b) PURPOSES.-The purposes of this Act are-
(1) to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people; and
(2) to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on Federal lands for scientific, education, or recreational purposes.
(c) POLICY.-It is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves.

SEC. 3. DEFINITIONS.
For purposes of this Act:
(1) CAVE.-The term "cave" means any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other man-made excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or man-made. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance.

(2) FEDERAL LANDS.-The term "Federal lands" means lands the fee title to which is owned by the United States and administered by the Secretary of Agriculture or the Secretary of the Interior.

(3) INDIAN LANDS-The term "Indian lands" means lands of Indian tribes or Indian individuals which are either held in trust by the United States for the benefit of an Indian tribe or subject to a restriction against alienation imposed by the United States.

(4) INDIAN TRIBE.-The term "Indian tribe" means any Indian tribe, band, nation, or other organized group or community of Indians, including any Alaska Native village or regional or village corporation as defined in, or established pursuant to, the Alaska Native Claims Settlement Act (43 U.S.C 1601 et seq.).

(5) CAVE RESOURCE.-The term "cave resource" includes any material or substance occurring naturally in caves on Federal lands, such as animal life, plant life, paleontological deposits, sediments, minerals, speleogens, and speleothems.

(6) SECRETARY.-The term "Secretary" means the Secretary of Agriculture or the Secretary of the Interior, as appropriate.

(7) SPELEOTHEM-The term "speleothem" means any natural mineral formation or deposit occurring in a cave or lava tube, including but not limited to any stalactite, stalagmite, helictite, cave flower, flowstone, concretion, drapery, rimstone, or formation of clay or mud.

(8) SPELEOGEN.-The term "speleogen" means relief features on the wails, ceiling and floor of any cave or lava tube which are part of the surrounding bedrock, including but not limited to anastomoses, scallops, meander niches, petromorphs and rock pendants in solution caves and similar features unique to volcanic caves.

SEC. 4. MANAGEMENT ACTIONS.

(a) REGULATIONS-Not later than nine months after the date of the enactment of this Act, the Secretary shall issue such regulations as he deems necessary to achieve the purposes of this Act. Regulations shall include, but not be limited to, criteria for the identification of significant caves. The Secretaries shall cooperate and consult with one another in preparation of the regulations. To the extent practical, regulations promulgated by the respective Secretaries should be similar.

(b) IN GENERAL-The Secretary shall take such actions as may be necessary to further the purposes of this Act. These actions shall include (but not be limited to: identification of significant caves on federal lands;

(1)(A) The Secretary shall prepare an initial list of significant caves for lands under his jurisdiction not later than one year after the publication of final regulations using the significance criteria defined in such regulations. Such a list shall be developed after consultation with appropriate private sector interests, including cavers.

(B) The initial list of significant caves shall be updated periodically, after consultation with appropriate private sector interests, including cavers. The Secretary shall prescribe by policy or regulation the requirements and process by which the initial list will be updated, including management measures to assure that caves under consideration for the list are protected during the period of consideration. Each cave recommended to the Secretary by interested groups for possible inclusion on the list of significant caves shall be considered by the Secretary according to the requirements prescribed pursuant to this paragraph, and shall be added to the list if the Secretary determines that the cave meets the criteria for significance as defined by the regulations.

(2) regulation or restriction of use of significant caves, as appropriate;

(3) entering into volunteer management agreements with persons of the scientific and recreational caving community; and

(4) appointment of appropriate advisory committees.

(c) PLANNING AND PUBLIC PARTICIPATION.- The Secretary shall-

(1) ensure that significant caves are considered in the preparation or implementation of any land management plan if the preparation or revision of the plan began after the enactment of this Act;

(2) foster communication, cooperation, and exchange of information between land managers, those who utilize caves, and the public.

SEC. 5. CONFIDENTIALITY OF INFORMATION CONCERNING NATURE AND LOCATION OF SIGNIFICANT CAVES.

(a) IN GENERAL.-Information concerning the specific location of any significant cave may not be made available to the public under section 552 of title 5, United States Code, unless the Secretary determines that disclosure of such information would further the purposes of this Act and would not create a substantial risk of harm, theft, or destruction of such cave.

(b) EXCEPTIONS.-Notwithstanding subsection (a), the Secretary may make available information regarding significant caves upon the written request by Federal and state governmental agencies or bona fide educational and research institutions.

Any such written request shall, at a minimum:

(1) describe the specific site or area for which information is sought;

(2) explain the purpose for which such information is sought; and

(3) include assurances satisfactory to the Secretary that adequate measures are being taken to protect the confidentiality of such information and to ensure the protection of the significant cave from destruction by vandalism and unauthorized use.

SEC. 6. COLLECTION AND REMOVAL FROM FEDERAL CAVES.

(a) PERMIT.-The Secretary is authorized to issue permits for the collection and removal of cave resources under such terms and conditions as the Secretary may impose, including the posting of bonds to insure compliance with the provisions of any permit.

(1) Any permit issued pursuant to this section shall include information concerning the time, scope, location, and specific purpose of the proposed collection, removal or associated activity, and the manner in which such collection, removal, or associated activity is to be performed must be provided.

(2) The Secretary may issue a permit pursuant this subsection only if he determines that the proposed collection or removal activities are consistent with the purposes of this Act and with other applicable provisions of law.

(b) REVOCATION OF PERMIT.-Any permit issued under this section shall be revoked by the Secretary upon a determination by the Secretary that the permittee has violated any provision of this Act, or has failed to comply with any other condition upon which the permit was issued. Any such permit shall be revoked by the Secretary upon assessment of a civil penalty against the permittee pursuant to section 8 or upon the permittee's conviction under section 7 of this Act. The Secretary may refuse to issue a permit under this section to any person who has violated any provision of this Act or who has failed to comply with any condition of a prior permit.

(c) TRANSFERABILITY OF PERMITS. Permits issued under this act are not transferable.

(d) CAVE RESOURCES LOCATED ON INDIAN LANDS.-

(1)(A) Upon application by an Indian tribe, the Secretary is authorized to delegate to the tribe all authority of the Secretary under this section with respect to issuing and enforcing permits for the collection or removal of any cave resource located on the affected Indian lands.

(B) In the case of any permit issued by the Secretary for the collection or removal of any cave resource, or to carry out activities associated with such collection or

removal, from any cave resource located on Indian lands (other than permits issued pursuant to subparagraph (A)), the permit may be issued only after obtaining the consent of the Indian or Indian Tribe owning or having jurisdiction over such lands. The permit shall include such reasonable terms and conditions as may be requested by such Indian or Indian Tribe.

(2) If the Secretary determines that the issuance of a permit pursuant to this section may result in harm to, or destruction of, any religious or cultural site, the Secretary, prior to issuing such permit, shall notify any Indian tribe which may consider the site as having significant religious or cultural importance. Such notice shall not be deemed a disclosure to the public for purposes of section 5.

(3) A permit shall not be required under this section for the collection or removal of any cave resource located on Indian lands or activities associated with such collection, by the Indian or Indian tribe owning or having jurisdiction over such lands.

(e) EFFECT OF PERMIT-No action specifically authorized by a permit under this section shall be treated as a violation of section 7.

SEC. 7. PROHIBITED ACTS AND CRIMINAL PENALTIES.

(a) PROHIBITED ACTS.-

(1) Any person who, without prior authorization from the Secretary knowingly destroys, disturbs, defaces, mars, alters, removes or harms any significant cave or alters the free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intention of committing any act described in this paragraph shall be punished in accordance with subsection (b).

(2) Any person who possesses, consumes, sells, barters or exchanges, or offers for sale, barter or exchange, any cave resource from a significant cave with knowledge or reason to know that such resource was removed from a significant cave located on Federal lands shall be punished in accordance with subsection (b).

(3) Any person who counsels, procures, solicits, or employs any other person to violate any provisions of this subsection shall be punished in accordance with subsection (b).

(4) Nothing in this section shall be deemed applicable to any person who was in lawful possession of a cave resource from a significant cave prior to the date of enactment of this Act.

(b) PUNISHMENT: Punishment for violating any provision of subsection (a) shall be ¡mprisonment of not more than one year or a fine in accordance with the applicable provisions of title 18 of the United States Code, or both. In the case of a second or subsequent violation, the punishment shall be imprisonment of not more than 3 years or a fine in accordance with the applicable provisions of title 18 of the United States Code, or both.

SEC. 8. CIVIL PENALTIES.

(a) ASSESSMENT.-(t) The Secretary may issue an order assessing a civil penalty against any person who violates any prohibition contained in this Act, any regulation promulgated pursuant to this Act, or any permit issued under this Act. Before issuing such an order, the Secretary shall provide such person written notice and the opportunity to request a hearing on the record within 30 days. Each violation shall be a separate offense, even if such violations occurred at the same time.

(1) The amount of such civil penalty shall be determined by the Secretary taking into account appropriate factors, including (A) the seriousness of the violation; (B) the economic benefit (if any) resulting from the violation; (C) any history of such violations; and (D) such other matters as the Secretary deems appropriate. The maximum fine permissible under this section is $10,000.

(b) JUDICIAL REVIEW.-Any person aggrieved by an assessment of a civil penalty under this section may file a petition for judicial review of such assessment with the United States District Court for the District of Columbia or for the district in which the violation occurred. Such a petition shall be filed within the 30-day period beginning on the date the order assessing the civil penalty was issued.

(c) COLLECTION-If any person fails to pay an assessment of a civil penalty-

(1) within 30 days after the order was issued under subsection (a), or

(2) if the order is appealed within such 30 day period, within 10 days after the court has entered a final judgment in favor of the Secretary under subsection (b), the Secretary shall notify the Attorney General and the Attorney General shall bring a civil action in an appropriate United States district court to recover the amount of penalty assessed (plus costs, attorneys fees, and interest at currently prevailing rates from the date the order was issued or the date of such final judgment, as the case may be). In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review.

(d) SUBPOENAS.-The Secretary may issue subpoenas in connection with proceedings under this subsection compelling the attendance and testimony of witnesses and subpoenas duces tecum, and may request the Attorney General to bring an action to enforce any subpoena under this section. The district courts shall have jurisdiction to enforce such subpoenas and impose sanctions.

SEC 9. MISCELLANEOUS PROVISIONS.

(a) AUTHORIZATION.-There are authorized to be appropriated $100,000 to carry out the purposes of this Act.

(b) EFFECT ON LAND MANAGEMENT PLANS.

-Nothing in this act shall require the amendment or revision of any land management plan, the preparation of which began prior to the enactment of this Act.

(c) FUND-Any money collected by the United States as permit fees for collection and removal of cave resources; received by the United States as a result of the forfeiture of a bond or other security by a permittee who does not comply with the requirements of such permit issued under section 7; or collected by the United States by way of civil penalties or criminal fines for violations of this Act shall be placed in a special fund in the Treasury. Such monies shall be available for obligation or expenditure (to the extent provided for in advance in appropriation Acts) as determined by the Secretary for the improved management, benefit, repair, or restoration of significant caves located on Federal lands.

(d) Nothing in this act shall be deemed to affect the full operation of the mining and mineral leasing laws of the United States, or otherwise affect valid existing rights.

SEC. 10. SAVINGS PROVISIONS.

(a) WATER.-Nothing in this Act shall be construed as authorizing the appropriation of water by any Federal, State, or local agency, Indian tribe, or any other entity or individual. Nor shall any provision of this Act-

(1) affect the rights or jurisdiction of the United States, the States, Indian tribes, or other entities over water of any river or stream or over any groundwater resource;

(2) alter, amend, repeal, interpret, modify, or be in conflict with any interstate compact made by the States; or

(3) alter or establish the respective rights of States, the United States, Indian tribes, or any person with respect to any water or water-related right.

(b) FISH AND WILDLIFE.-Nothing in this Act shall be construed as affecting the jurisdiction or responsibilities of the States with respect to fish and wildlife.

Appendix F. National Cave and Karst Research Institute Act of 1998

The National Cave and Research Institute Act of 1998 was formed to gather information regarding cave and karst, promote information exchange and education, and foster environmentally sound management practices. Part of this Act includes the development of a centralized location to facilitate these objectives. This location is near National Park lands in New Mexico.

SECTION 1. SHORT TITLE
This Act may be cited as the `National Cave and Karst Research Institute Act of 1998'.

SECTION 2. PURPOSES
The purposes of this Act are-

1. to further the science of speleology;
2. to centralize and standardize speleological information;
3. to foster interdisciplinary cooperation in cave and karst research programs;
4. to promote public education;
5. to promote national and international cooperation in protecting the environment for the benefit of cave and karst landforms; and
6. to promote and develop environmentally sound and sustainable resource management practices.

SECTION 3. ESTABLISHMENT OF THE INSTITUTE

- MANAGEMENT- The Institute shall be jointly administered by the National Park Service and a public or private agency, organization, or institution, as determined by the Secretary.
- GUIDELINES- The Institute shall be operated and managed in accordance with the study prepared by the National Park Service pursuant to section 203 of the Act entitled `An Act to conduct certain studies in the State of New Mexico', approved November 15, 1990 (Public Law 101-578; 16 U.S.C. 4310 note).
- CONTRACTS AND COOPERATIVE AGREEMENTS- The Secretary may enter into a contract or cooperative agreement with a public or private agency, organization, or institution to carry out this Act.

SECTION 4. ADMINISTRATION OF THE INSTITUTE

- FACILITY-
    1. LEASING OR ACQUIRING A FACILITY- The Secretary may lease or acquire a facility for the Institute.
    2. CONSTRUCTION OF A FACILITY- If the Secretary determines that a suitable facility is not available for a lease or acquisition under paragraph (1), the Secretary may construct a facility for the Institute.
- ACCEPTANCE OF GRANTS AND TRANSFERS- To carry out this Act, the Secretary may accept-
    1. a grant or donation from a private person; or
    2. a transfer of funds from another Federal agency.

SECTION 5. FUNDING

- MATCHING FUNDS- The Secretary may spend only such amount of Federal funds to carry out this Act as is matched by an equal amount of funds from non-Federal sources.
- AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necessary to carry out this Act.

Appendix G. Proper House Exclusions

Proper house exclusions are important for conserving bats, such as little brown bats or big brown bats, that concentrate roosts in houses or other buildings. The following is an article published in the South Dakota Conservation Digest that reports methods to properly exclude bats from buildings. The author of this article, Joel Tigner, is a bat biologist and the owner of Batworks, a consulting firm specializing in bat study and bat-friendly exclusion.

BATS IN BUILDINGS

Joel Tigner

Having "bats in the belfry" usually means that a person is considered crazy or erratic. The phrase derives from observations of bat use of a tall structure, such as a watchtower, and the flurry of activity as they leave at dusk. In modern times, few people own actual belfries, but they may have bats in their attic, garage, or other building sites. This article provides an overview of bats in buildings and describes how to deal with unwanted roosts.

Timing is absolutely crucial when dealing with unwanted bat roosts. If you follow the guidelines outlined below at the wrong time of year, you may create new problems for the roost owner.

First, a bit about bats ... Bats are not rodents. They do not make or enlarge holes in buildings, they do not chew wiring, and they do not build nests. They use a structure just as they find it, although they may cause damage. Over time, a large roost can damage a building because of accumulation of urine and droppings. Bat urine has a very pungent odor, particularly noticeable during warm weather. A homeowner needn't worry about rodent-like building damage, although removing the urine odor can be difficult without replacing affected building materials.

The same bats will use the same roosts from year to year. If you have bats this year, they will likely return next year unless you exclude them from the building.

Exclusion is the best way to deal with unwanted bats in buildings. Exclusion is a process by which bats are sealed out of a structure. Exclusions must be performed at the appropriate time of year and follow certain guidelines.

Why not use poisons?

Poisoning bats is illegal and irresponsible. Poisoning attempts seldom kill all the bats, leaving sickened bats that emerge, become grounded, and may be retrieved by children and pets. Poisoning also fails to address the real issue - that bats are gaining access to your structure in the first place. As bats are mammals, anything harmful to them will also be harmful to you and your pets.

In South Dakota, groups of bats in buildings are typically members of maternity/nursery roosts. In general, maternity roosts may number from less than 10 to more than 1,000 bats. Typical roost size in South Dakota is 20-30 bats. Bats differ from most other small mammals in that they give birth only once a year and generally only to a single pup. Adult females come together in the early spring to give birth and rear their pups. These roosts can form from wider areas with reproductive females sometimes traveling great distances to benefit from collective roosting. Considering the large area from which females may gather and the low reproductive rate of bats, destroying such roosts can have serious impacts to a particular population or species.

Exclusions must be timed to be completed before the females have given birth or postponed until after the pups have learned to fly. Optimal exclusion dates vary with a year's weather conditions, but in general, exclusions in South Dakota should not be done between mid-May and September 1.

Seasonal visitors

Most groups of bats in buildings are seasonal visitors, arriving in the spring and departing in the late summer or early fall. Bat species that roost collectively in buildings must hibernate during the winter, as there is no insect prey available. Buildings typically do not provide the necessary conditions for bats to survive the winter. As cold weather approaches, they begin to move out of their summer

roost and head for their hibernation sites (or to warmer climates farther south). By the time cold weather arrives, nearly all the bats will have left buildings. The ideal time to do exclusions is either after the bats have left for the winter or early in the spring before their arrival.

NOTABLE EXCEPTION - One particularly robust species, the Big Brown Bat *(Eptesicus fuscus)* has been known to winter in buildings in South Dakota, but not much is known about the extent of their winter building use. Buildings most likely to be used for hibernation generally contain brick or block sections (including foundations) where the bats can find a more stable temperature. Bats often move from their entry point to a distant location in the structure via cavities in walls to find their optimal seasonally specific temperature. Bat exclusion in buildings with such features should employ a more conservative treatment plan to prevent entrapping over-wintering bats. (Entrapment frequently causes bats to seek alternative ways to exit the structure, which may lead to their inadvertently entering the living space and confronting human inhabitants. In general, neither party is amused by such encounters.)

Excluding unwanted bat roosts

If you read the important preceding information and have decided to evict your bat tenants, here is the method to use when bats are (or may be) in residence. The following should only be used in roosts of less than 100 bats. For larger roosts, contact an experienced bat exclusion specialist for advice.

1 - Identify the bats' favorite point of entry (there may be more than one). If there is more than one point of access but you are certain they are connected within the structure (different openings leading into the same soffit, for example), you may proceed with the following directions. If you are uncertain the sites are connected or they are in different parts of the structure, each roost should be treated separately.

Identifying the entry point is usually not too difficult. Bat droppings may accumulate beneath the access points or a dark staining is sometimes visible around access points found in light-colored materials. If you have no idea where they are entering the structure, position yourself and some friends around the outside of the house at dusk to watch for the bats' nightly emergence. Do this on a warm, calm evening, since cool temperatures or rain will usually delay or prevent bat emergence.

2 - Once you have identified the entry point, thoroughly examine the structure during daylight hours and identify any additional openings. This is probably the single-most important step in the entire procedure. Many openings may not be visible from a ground level vantagepoint, particularly for multi-story structures. Use binoculars or examine the structure from a ladder.

3 - All openings <u>except</u> the bat's entry point should be sealed. Many people believe bats are larger than they actually are, requiring large holes to gain access. Some species are smaller than others, but you should fill any opening larger than ½ inch. (Smaller species can use the trough in the pointing between the ends of two bricks to pass under the fascia board and gain access to the soffit.) Use a good quality caulk to seal smaller holes or crevices and expanding aerosol foam for larger openings. (Remember: bats are not rodents; they do not make or enlarge holes. It is absolutely essential to identify and seal all potential entry points, except for the known entrance.)

If the building has vents at the ends, check carefully to be sure they are screened. Even if vents appear to be screened, check for unfastened corners or holes that may be difficult to see with a cursory look. Also check around flashing for other easily missed access points. If possible, enter the attic with the lights off (during daylight hours) and note places where you can see daylight.

The single most common bat entry points in western South Dakota are small gaps between an exterior chimney and where it adjoins the house. Fill all gaps on both sides of the chimney except for a single two-inch gap at the point where you've seen the bats enter or emerge.

When you are finished sealing all potential entry points, the only entrance to the structure should be the identified bat access.

4 - Over this final opening, temporarily install what will be a one-way escape vent or chute. This vent is fashioned from heavy mil plastic or poly tarp material, sized approximately 24 inches in overall length, and shaped as a cone (similar to a windsock). Duct tape works well to hold the cone together (put the tape on the exterior of the cone so the interior remains smooth). The large end of the cone should be large enough to cover the opening the bats have been using plus a couple of inches surrounding the opening. The small end of the cone should have a hole with a diameter about the size of your thumb. Attach the large end of the cone over this last opening in the structure, making sure to completely seal all the way around the cone. Duct tape works well for attaching the vent. The bats must not be able to emerge anywhere except through the small end of the funnel. The cone should hang away from the side of the house and not lie flat against the structure (that's the reason for using a heavier material like the poly tarp).

5 - . Leave the vent in place for 5 to 7 nights of good weather to give all bats the opportunity to get out. They can emerge but cannot get back into the building. At the end of this time, remove the cone and immediately seal this final opening.
If you have not missed any other openings, you have solved your bat problem.

REMEMBER: Simply blocking the bats' access holes without first treating the entire structure will usually result in the bats finding an alternate entry point. If done at the wrong time of year (see above for acceptable dates), you may simply exclude the adult females and entrap juveniles not yet able to fly. This generally leads to more determination on the part of the adult females to find another way to get back to their pups, which can often result in bats gaining access to the human living space. In addition, when the mother does not return, the juveniles begin to search for mom and often end up crawling into the human living space.

A NOTE OF CAUTION: Be forewarned that any activity on a ladder at any openings in the structure may startle an unseen roosting bat into flight. Try not to work immediately in front of or directly beneath an access point. Such a surprise can easily cause a fall from a ladder. Where possible, place your ladder to one side of your work area.

Where do we go now? Consider erecting an alternative roost location for your newly evicted bats, such as a "bat box." Designs and tips are available at Bat Conservation International's web-site: (http://www.batcon.org). Design and placement should be appropriate for the roost size and species. It is best to have this roosting alternative in place well before the exclusion is performed.

Properly timing exclusion of unwanted bats from roosts in combination with providing appropriate roosting alternatives (where applicable) is a workable, responsible method to deal with bat-related problems. Preventing contacts between bats and humans and bats and pets should be the goal of any control program, but this need not be done at the expense of the bats. The contribution of bats to a healthy ecosystem as the main predators of night-flying insects (many of which are forestry and agricultural pests) far outweighs any associated risks.

For more information about bats in South Dakota, consult the following website: http://nat_hist.sdstate.edu/SDBWG/SDBWG.htmi.

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Appendix H. Rabies Information

Rabies information is vital to understanding rabies and how humans might be infected. Bats may be infected with rabies though not to the extent as other species, such as skunks. The following information regarding rabies was provided by the Center for Disease Control through their website: http://www.cdc.pov/ncidod/dvrd/rabiesBats & Rabies/bats&.htm. The Center for Disease Control has standards with dealing with potential rabid species, and the South Dakota Department of Health adheres to those standards.

What is rabies and how do people get it?

Rabies is an infectious viral disease that affects the nervous system of humans and other mammals. People get rabies from the bite of an animal with rabies (a rabid animal). Any wild mammal, like a raccoon, skunk, fox, coyote, or bat, can have rabies and transmit it to people. It is also possible, but quite rare, that people may get rabies if infectious material from a rabid animal, such as saliva, gets directly into their eyes, nose, mouth, or a wound.

Because rabies is a fatal disease, the goal of public health is, first, to prevent human exposure to rabies by education and, second, to prevent the disease by anti-rabies treatment if exposure occurs. Tens of thousands of people are successfully treated each year after being bitten by an animal that may have rabies. A few people die of rabies each year in the United States, usually because they do not recognize the risk of rabies from the bite of a wild animal and do not seek medical advice.

Why should I learn about bats and rabies?

Most of the recent human rabies cases in the United States have been caused by rabies virus from bats. Awareness of the facts about bats and rabies can help people protect themselves, their families, and their pets. This information may also help clear up misunderstandings about bats.

When people think about bats, they often imagine things that are not true. Bats are not blind. They are neither rodents nor birds. They will not suck your blood -- and most do not have rabies. Bats play key roles in ecosystems around the globe, from rain forests to deserts, especially by eating insects, including agricultural pests. The best protection we can offer these unique mammals is to learn more about their habits and recognize the value of living safely with them.

How can I tell if a bat has rabies?

Rabies can be confirmed only in a laboratory. However, any bat that is active by day, is found in a place where bats are not usually seen (for example, in a room in your home or on the lawn), or is unable to fly, is far more likely than others to be rabid. Such bats are often the most easily approached. Therefore, it is best never to handle any bat.

What should I do if I come in contact with a bat?

If you are bitten by a bat -- or if infectious material (such as saliva) from a bat gets into your eyes, nose, mouth, or a wound -- wash the affected area thoroughly and get medical advice immediately. Whenever possible, the bat should be captured and sent to a laboratory for rabies testing (see: How can I safely capture a bat in my home?).

People usually know when they have been bitten by a bat. However, because bats have small teeth which may leave marks that ate not easily seen, there are situations in which you should seek medical advice even in the absence of an obvious bite wound. For example, if you awaken and find a bat in your room, see a bat in the room of an unattended child, or see a bat near a mentally impaired or intoxicated person, seek medical advice and have the bat tested.

People cannot get rabies just from seeing a bat in an attic, in a cave, or at a distance. In addition, people cannot get rabies from having contact with bat guano (feces), blood, or urine, or from touching a bat on its fur (even though bats should never be handled!).

What should I do if my pet is exposed to a bat?

If you think your pet or domestic animal has been bitten by a bat, contact a veterinarian or your health department for assistance immediately and have the bat tested for rabies. Remember to keep vaccinations current for cats, dogs, and other animals.

How can I keep bats out of my home?

Some bats live in buildings, and there may be no reason to evict them if there is little chance for contact with people. However, bats should always be prevented from entering rooms of your home. For assistance with "bat-proofing" your home, contact an animal-control or wildlife conservation agency. If you choose to do the "bat-proofing" yourself, here are some suggestions. Carefully examine your home for holes that might allow bats entry into your living quarters. Any openings larger than a quarter-inch by a half-inch should be caulked. Use window screens, chimney caps, and draft-guards beneath doors to attics, fill electrical and plumbing holes with stainless steel wool or caulking, and ensure that all doors to the outside close tightly.

Additional "bat-proofing" can prevent bats from roosting in attics or buildings by covering outside entry points. Observe where the bats exit at dusk and exclude them by loosely hanging clear plastic sheeting or bird netting over these areas. Bats can crawl out and leave, but cannot re-enter. After the bats have been excluded, the openings can be permanently sealed. For more information about "bat-proofing" your home, contact Bat Conservation International.

Things to remember when "bat-proofing"

- During summer, many young bats are unable to fly. If you exclude adult bats during this time, the young may be trapped inside and die or make their way into living quarters. Thus, if possible, avoid exclusion from May through August.
- Most bats leave in the fall or winter to hibernate, so these are the best times to "bat-proof' your home.

How can I safely capture a bat in my home?

If a bat is present in your home and you cannot rule out the possibility of exposure, leave the bat alone and contact an animal-control or public health agency for assistance. If professional help is unavailable, use precautions to capture the bat safely, as described below.

What you will need:

- leather work gloves (put them on)
- small box or coffee can
- piece of cardboard
- tape

When the bat lands, approach it slowly, while wearing the gloves, and place the box or coffee can over it. Slide the cardboard under the container to trap the bat inside. Tape the cardboard to the container securely, and punch small holes in the cardboard, allowing the bat to breathe. Contact your health department or animal-control authority to make arrangements for rabies testing.

If you see a bat in your home and you are sure no human or pet exposure has occurred, confine the bat to a room by closing all doors and windows leading out of the room except those to the outside. The bat will probably leave soon. If not, it can be caught, as described, and released outdoors away from people and pets.

How can rabies be prevented?

- Teach children never to handle unfamiliar animals, wild or domestic, even if they appear friendly. "Love your own, leave other animals alone" is a good principle for children to learn.

- Wash any wound from an animal thoroughly with soap and water and seek medical attention immediately.
- Have all dead, sick, or easily captured bats tested for rabies if exposure to people or pets occurs.
- Prevent bats from entering living quarters or occupied spaces in homes, churches, schools, and other similar areas where they might contact people and pets.
- Be a responsible pet owner by keeping vaccinations current for all dogs, cats, and ferrets, keeping your cats and ferrets inside and your dogs under direct supervision, calling animal control to remove stray animals from your neighborhood, and consider having your pets spayed or neutered.

Case study

In February 1995, the aunt of a 4-year-old girl was awakened by the sounds of a bat in the room where the child was sleeping. The child did not wake up until the bat was captured, killed, and discarded. The girl reported no bite, and no evidence of a bite wound was found when she was examined. One month later the child became sick and died of rabies. The dead bat was recovered from the yard and tested--it had rabies.

This case demonstrates several points:

- This child's infection with rabies was most likely the result of a bat bite. Children sleep heavily and may not awaken from the presence of a small bat. A bat bite can be superficial and not easily noticed.
- The bat was behaving abnormally. Instead of hiding, the bat was making unusual noises and was having difficulty flying. This strange behavior should have led to a strong suspicion of rabies.
- If the bat had been submitted for rabies testing, a positive test would have led to life-saving anti-rabies treatment.

Remember, in situations in which a bat is physically present and you cannot reasonably rule out having been bitten, safely capture the bat for rabies testing and seek medical attention immediately.

Are bats beneficial?

Yes. Worldwide, bats are a major predator of night-flying insects, including pests that cost farmers billions of dollars annually. Throughout the tropics, seed dispersal and pollination activities by bats are vital to rain forest survival. In addition, studies of bats have contributed to medical advances including the development of navigational aids for the blind. Unfortunately, many local populations of bats have been destroyed and many species are now endangered.

Where can I learn more about bats?

For information on bats in South Dakota...

South Dakota Game, Fish and Parks
523 E Capitol Ave
Pierre, SD 57501
605-773-3387
http://www.state.sd.us/gfp/

South Dakota Bat Working Group
Brad Phillips, President
3406 Ivy Ave
Rapid City, SD 57701
http://nat_hist.sdstate.edu/SDBWG/SDBWG.html

For information on bats in the western United States...
Western Bat Working Group
Lyle Lewis, Chairman
2105 Osuna Road NE
Albuquerque, NM 87109
(505) 346-2525 ext 14
http://www.batworkinggroups.org/

For information on bats in United States...
Bat Conservation International, Inc.
P O Box 162603
Austin, TX 78716
1-800-538-BATS
www.batcon.org

For information on federally listed species...
U S Fish and Wildlife Service
420 S. Garfield Avenue, Suite 400
Pierre, SD 57501-5408
605-224-8693
http://southdakotafieldoffice.fws.gov/

Where can I learn more about rabies?
For information on rabies and national infection rates...
Center for Disease Control and Prevention
1600 Clifton Rd.
Atlanta, GA 30333
1-800-311-3435
http://www.cdc.gov/ncidod/dvrd/rabies/

For information on rabies in South Dakota...
South Dakota Department of Health
615 E Fourth Street
Pierre, SD 57501-1700
1-800-592-1861
http://www.state.sd.us/doh/

For information on rabies testing in South Dakota...
Animal Disease Research and Diagnostic Laboratory
Department of Veterinary Science, South Dakota State University
Box 2175, North Campus Drive
Brookings, SD 57007-1396
605-688-5171
http://vetsci.sdstate.edu/

For information on veterinary and regulatory issues...
South Dakota Animal Industry Board
441 S Fort Street
Pierre, SD 57501-4503
605-773-3321
http://www.state.sd.us/aib/

Appendix I. Conservation Digest Articles

The South Dakota Conservation Digest is published bimonthly by South Dakota Game, Fish and Parks. The Natural Heritage Program has a column within the Conservation Digest called Dakota Natural Heritage that is used to publish articles on nongame species in South Dakota. Following were two articles published in the Dakota Natural Heritage section of the Conservation Digest. One article discussed Townsend's big-eared bats, and one article discussed South Dakota's tree bats. Eileen Dowd Stukel wrote both articles concerning bats in South Dakota. Eileen is a senior wildlife biologist for South Dakota Game, Fish and Parks and the coordinator of the Wildlife Diversity Program.

TOWNSEND'S BIG-EARED BAT

Eileen Dowd Stukel

When I was a little girl, I was terrified to visit the large city park next door after dark. My brothers had convinced me that the bats flittering through the air would entangle themselves in my hair. After futile attempts to free themselves, the bats would have to be removed by chopping my hair off.

This ridiculous bat myth is still believed by many, along with other incredible myths and superstitions. Why are bats the objects of such fear and suspicion? A common characteristic of most human fears is a lack of understanding. Combine this ignorance with a bat's secretive and nocturnal ways, its unusual appearance and its association with Count Dracula, and you have a serious public relations challenge.

If we're willing to set aside our preconceptions about bats, we can quickly come to appreciate this remarkable group of mammals. There are approximately 1000 bat species worldwide, and they are very similar to bat fossils 50 million years old. Bats are grouped in the Order Chiroptera, which translates to "hand-wing". Bats are the only true flying mammals, with elongated hands and fingers to support wing membranes. Diversity among bat species is immense. Bat sizes range from the world's smallest mammal, the bumblebee bat of Thailand, weighing less than a penny, to the flying foxes, some with wingspans up to six feet.

I had a recent conversation with someone about endangered species. After each description of a few of the rarest species found in South Dakota, the individual would ask: "But what's it good for?" Answering this question about bats is simple. In both the New and Old World tropics, many economically important plants rely on bat species for pollination. These include bananas, avocados, dates, figs, peaches, cashews, carob, mangoes, and even the tequila plant, from which we derive mescal. The African baobab, commonly called the "tree of life", is bat-pollinated, one of over 300 tropical plants of Asia and Africa that depends on bats for pollination or seed dispersal.

On a more selfish note, North American bats truly are insect-catching machines. As the major predator of night-flying insects, bats consume enormous quantities of mosquitoes, as well as many agricultural insect pests, including grasshoppers, corn borers, potato beetles and grain and cutworm moths. One little brown bat, a common North American species, can catch 600 mosquitoes per hour.

Despite their tremendous economic and ecological values, many bat species have declined. The tiny bumblebee bat is an endangered species, as are seven bat species found in the United States. The Townsend's big-eared bat is considered a rare and vulnerable species in South Dakota. This

species, sometimes called the lump-nosed or long-nosed bat, is found mainly in caves of western North America. Smaller populations are scattered through parts of the southern Great Plains, the Ozarks of Missouri, Arkansas and Oklahoma and portions of Virginia and West Virginia. Two subspecies, the Ozark big-eared bat and Virginia big-eared bat, are endangered. In South Dakota, this species has been found in caves and abandoned mine tunnels of seven western counties, in both nursery and hibernation colonies.

Female big-eared bats mate during October and November of their first year. Like most North American bats, this species exhibits delayed ovulation and fertilization. Not until the spring following fall mating is an egg released from the female's ovary, to unite with the sperm for fertilization. In the meantime, both sexes gather in caves and mines for hibernation, one of two winter options for an insect-eater. This species typically doesn't migrate for any great distance, but instead forms hibernation clusters of a few to several hundred bats in caves or mines with temperatures of 55 degrees F or less. Their sensitivity to temperature changes can cause them to shift to different sites within a cave or even to other caves during hibernation. Big-eared bats usually select the cool, well-ventilated parts of a cave, where they hang from an open ceiling.

Ovulation and fertilization occur usually just after bats have left their winter quarters. Pregnant females gather in nursery colonies, where they give birth to one young each, after a gestation period of 8-14 weeks. A big-eared bat is relatively large at birth, measuring one-quarter of its mother's size. During daytime roosting, young suckle and cling to their mothers. They are soon left in clusters as the females forage, leaving after dark in search of night-flying moths. A newborn can "chirp" a few hours after birth. It's possible that this vocalization may help a mother recognize her infant when she returns to the maternity roost.

Young big-eared bats grow rapidly, are flighted by three weeks of age and weaned at two months. By this time, usually late in the summer, nursery colonies disperse, to reform the following spring. Townsend's big-eared bats are extremely faithful to maternity roosts, returning annually if not disturbed or displaced.

This species is not considered common anywhere in its range, possibly due to its extreme sensitivity to disturbance. If disturbed in a maternity colony, pregnant females may abort or resorb an embryo. Mothers with young may drop their infants in panic or abandon helpless young at a maternity site. In any case, this can be a serious population loss for a species that gives birth to only one young per year.

Hibernating bats are likewise at great risk when disturbed, either accidentally or intentionally. Bats prepare for hibernation by adding fat that may amount to one-third of their body weight. This fat store is drastically depleted if a bat is aroused during hibernation. Each disruption can result in a bat losing up to 30 days worth of its winter fat storage.

What can you do to help this unique and sensitive element of our natural heritage?

1. Report any bat activity you see in South Dakota's caves or old mines. The Game, Fish and Parks Department, Black Hills National Forest and the Paha Sapa Grotto, a spelunking club, have embarked on an inventory of potential bat habitats in the Black Hills of South Dakota. Such information can help us identify and protect critical bat habitat for the eleven species found in the Black Hills.

2. Do not explore caves inhabited by bats. Human disturbance and persecution are two of the most serious threats to bats' survival. Unfortunately, many Black Hills caves aren't presently used by bats because of extensive human use, vandalism and soot build-up from campfires set inside caves.

3. Learn more about bats and their conservation by joining Bat Conservation International, a nonprofit organization dedicated to the worldwide conservation and management needs of bats. Membership information can be obtained by writing to:

Bat Conservation International
PO Box 162603
Austin, TX 78716

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SOUTH DAKOTA'S TREE BATS

Eileen Dowd Stukel

If you see a bat in South Dakota, it is likely to be a little brown bat or a big brown bat, two species commonly associated with buildings. Big brown and little brown bats are just two of the dozen or more bat species found in the state during some part of the year. Three of South Dakota's bat species are "tree bats," meaning that they prefer trees and forested areas for foraging, maternity, and resting sites.

South Dakota's tree bats are the hoary bat, the eastern red bat, and the silver-haired bat. In general, these tree bats may be seen almost anywhere in the state during migration, but their primary South Dakota breeding areas are in the Black Hills. In contrast to several species of the genus *Myotis,* which are difficult for anyone but an expert to distinguish, each of our tree bats is distinctive in appearance and quite beautiful.

The hoary bat *(Lasiurus cinereus) is* the largest bat species known in South Dakota, measuring 5 to 8 inches long and weighing ¾ to 1½ ounces. The fur is yellowish brown to mahogany colored with a silver frosted appearance, hence the name hoary bat. Longer hairs on the neck form a slight ruff. This bat ranges from southern Canada south through most of South America. The hoary bat is Hawaii's only native land mammal.

Hoary bats are mostly solitary, spending summer days hanging from tree branches in sites well covered by foliage above and open below. Hoary bats typically do not inhabit caves or buildings. Males and females come together only to mate in late summer or early fall. As is true for all bat species found in South Dakota, the male's sperm are dormant in the female until fertilization the following spring. The female typically gives birth to two pups during early summer. She carries her young until they are about a week old, then leaves them clinging to a twig or leaf during her nightly foraging trips. Young hoary bats can fly when 3 to 4 weeks old.

Hoary bats are often the last bats to begin foraging in the evening, starting several hours after sunset. Hoary bats do not hibernate in South Dakota, but rather travel south to warmer climates for the winter.

The red bat *(Lasiurus borealis) is* considered to be among the continent's most beautiful bats. Unlike most bat species, male and female red bats differ in color. The male's fur ranges from bright orange to pale yellowish-orange, with white-tipped hairs. Females have duller, buff chestnut fur, with longer gray-tipped hairs that create a somewhat frosted appearance. Red bats have a yellowish-white patch of hair on each shoulder. Weight ranges from 1/5 to ½ ounce, and total length is 3¾ to 4½ inches. The eastern red bat ranges throughout most of the eastern United States and southeastern Canada as far south as northeastern Mexico. South Dakota forms part of the western boundary of the species' range. Red bats apparently do not winter in South Dakota, and this species is the least common bat of the Black Hills.

Like the hoary bat, the red bat spends the day sheltered by the foliage of tree limbs or low shrubs, usually hanging by one foot from a leaf petiole, twig, or branch and often resembling a dead leaf. Red bats are relatively early foragers, starting their slow, erratic foraging flights in late afternoon. As darkness falls, they drop to tree level and lower in search of moths, crickets, flies, mosquitoes, and beetles. Red bats may also forage beneath artificial light sources, such as streetlights.

Eastern red bats mate in late summer, with sperm stored in the female until fertilization the following spring. A female red bat may have 1 to 5 pups in late spring or early summer. The mother leaves her pups hanging on tree limbs while she forages. She may relocate her young if disturbed. Red bats typically do not frequent caves or buildings.

The scientific name of the silver-haired bat *(Lasionycteris noctivagans)* describes its appearance *(Lasionycteris* is from Greek words meaning "hairy bat") and its lifestyle *(noctivagans* is from Latin words meaning "night wanderer"). The dark fur on the back is silver-tipped. This bat weighs 1/5 to 1/3 ounce and measures approximately 4 inches in length. This wide-ranging bat occurs from southeastern Alaska and central Canada across most of the U.S. southward to northeastern Mexico. Silver-haired bats generally do not hibernate in South Dakota. A research study in the Black Hills confirmed that large dead or dying ponderosa pines (snags) are important roosting sites.

The silver-haired bat inhabits both coniferous and deciduous forests and forest edges along waterways. Roost sites for this solitary bat include hollow trees, spaces under loose tree bark, woodpecker holes, and, less commonly, buildings. In areas with few trees, the silver-haired bat may roost in piles of fenceposts, boards, or bricks. Hibernation sites include hollow trees, rock crevices, mines, caves, and buildings.

Silver-haired bats mate in late summer. The male's sperm are stored in the female's body until fertilization the following spring. The female gives birth to two pups in early summer, and females with young may roost together. Nightly foraging begins several hours after sunset, with another foraging period 6 to 8 hours after sunset. Foraging flights are slow, leisurely, and sometimes not far aboveground near and over woodland wetlands. Silver-haired bats may repeat the same feeding circuit in search of moths, insects, mosquitoes, termites, and caddisflies.

All three of South Dakota's tree bat species bear more than one pup each year. Nearly all other bat species found in the state give birth to a single pup each year. These species, which include the familiar little brown and big brown bats, typically find safety from predators and inclement weather in buildings, caves, or abandoned mines, in contrast to tree bats, which are more vulnerable to predators and to the elements. The larger number of pups borne by female tree bats may help offset the added risks associated with their maternity and roosting habitats.

Henry David Thoreau said: "The universe is wider than our views of it." Our views of bats are still evolving from fear and loathing to a deeper understanding and fascination for these members of South Dakota's natural heritage.

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THE FRINGE-TAILED *MYOTIS (Myotis thysanodes pahasapensis)*

Alyssa Kiesow

Evil and mysterious creatures emerge at night that may threaten, stalk, and attack people, at least according to folklore and legend. Folklore and legend conjure up our deepest fears. But, what really is fear? Fear is derived from the unknown. Many people fear creatures of the night because little is known about these elusive animals-including bats. Bats are often persecuted for their appearance and their habits. Bats are not ugly, blood-sucking vampires that tangle in one's hair. Such rumors began long ago, thanks to folklore, legend, and myth. Folklore, legend, and myth depict certain creatures, like bats, as scary, problematic animals. Actually, bats are an important part of the ecosystem and provide economic and ecological benefits to people. As a result, many groups and individuals are beginning to work towards understanding and conserving these organisms in South Dakota.

Twelve bats are found in South Dakota. Throughout South Dakota bats concentrate near insect clusters, which usually occur above or below tree canopies and over water sources. But, these

areas are slowly disappearing. Due to loss of habitat (e.g., roosts) and adequate foraging areas, six bats are considered rare in South Dakota. Among these rare bats is the Black Hills fringe-tailed myotis *(Myotis thysanodes pahasapensis).*

The Black Hills fringe-tailed myotis is a medium-sized bat with black, long ears and dark, long fur. Its fur appears darker along its back than along its belly. Being nearly black, the wing membranes have stiff hairs along the free edge between the hind limbs. These noticeable stiff hairs help distinguish the Black Hills fringe-tailed myotis from other bats in South Dakota.

The Black Hills fringe-tailed myotis is exclusively found in the Black Hills. Habitat in the Black Hills-as most people already know-primarily consists of ponderosa pine *(Pinus ponderosa)* and undergrowth vegetation. The Black Hills fringe-tailed myotis selects habitats ranging from dry shrub to pine woodlands at moderate elevations. In these habitats, the Black Hills fringe-tailed myotis roosts in caves, mines, natural rock crevices, and buildings. These roosts are used year round. Therefore, males and females are considered year round residents in South Dakota and often collectively hibernate in caves and mines to survive through the winter.

Before hibernation, these bats mate. Females retain sperm in their reproductive tract until the following spring. At this point, ovulation occurs and the egg is fertilized. One pup is born after 50 to 60 days of development. Because bats are mammals, young are born alive. After the arrival of pups, mothers form nursery colonies. These colonies may grow very large-though most colonies average about 20 individuals-and are usually located in open areas of their roosts. During the summer, males typically roost separate from females and their young.

To feed her young, the female Black Hills fringe-tailed myotis must search for food. Usually, food is collected over vegetative canopy or water from sunset to midnight. Prey includes primarily beetles and moths. The Black Hills fringe-tailed myotis has a very graceful flight that is long, deliberate, and highly maneuverable-this flight pattern is noticeable while this bat is foraging.

As a result of their habits, the Black Hills fringe-tailed myotis and other bats are beneficial to people and the environment. Since many bats are economically important to agriculture and gardening and ecologically important to the ecosystem, it is important to protect bats in South Dakota-particularly bats that are rare as the Black Hills fringe-tailed myotis. Because the Black Hills fringe-tailed myotis is unique to the Black Hills, protecting this bat is very important. Education and knowledge play a large role in protecting bats and their habitats. Some people in South Dakota are actively learning and teaching about bats and their habitats. As more people learn to understand bats and their habitats, we will slowly begin to conserve these animals through knowledge rather than destroy them from folklore, legend, and myth.

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Appendix J. Literature Cited

Allen, J. A. 1895. List of mammals collected in the Black Hills region of South Dakota and in western Kansas by Mr. Walter W. Granger, with field notes by the collector. Bulletin of the American Museum of Natural History. American Museum of Natural History 7: 259-275.

Anderson, K. W., and J. K. Jones. 1971. Mammals of northwestern South Dakota. University of Kansas Publications, Museum of Natural History 19: 361-393.

Barbour, R. W., and W. H. Davis. 1969. Bat of America. University of Kentucky Press, Lexington, Kentucky, USA. 286pp.

BCI (Bat Conservation International). 2001. U. S. bats by states-South Dakota homepage. http://www.batcon.ora/discover/species/sd.html September 1999.

Betts, B. J. 1996. Roosting behavior of silver-haired bats *(Lasionycteris noctivagans)* and big brown bats *(Eptesicus fuscus)* in northeast Oregon. Pages 55-61 *in* Barclay, R. M. R., and Brigham, R. M., editors. Bats and forests symposium: October 19-21, 1995, British Columbia Ministry of Forests, Victoria, British Columbia, Canada.

Black, H. L. 1974. A north temperate bat community: structure and prey populations. Journal of Mammalogy 55: 138-157.

Brigham, R. M. 1991. Flexibility in foraging and roosting behavior by the big brown bat *(Eptesicus fuscus)*. Canadian Journal of Zoology 69: 117-121.

Cryan, P. M., and M. A. Bogan. 1996. Ecology and distribution of bats of the southern Black Hills, South Dakota: annual report. Jewel Cave National Monument unpublished report. 20pp.

CWF (Canadian Wildlife Federation). 2001. Attracting Wildlife homepage. http://www.wildaboutgardening.org/en/attracting/section4/ 11 July 2003.

Fenton, M. B., and R. M. R. Barclay. 1980. *Myotis lucifugus.* Mammalian Species 142: 1-8.

Findley, J. S. 1956. Mammals of Clay County. University of South Dakota, Vermillion, South Dakota, USA. 45pp.

Fitch, J. H., and K. A. Shump. 1979. *Myotis keenii.* Mammalian Species 121: 1-3.

Harvey, M. J., J. S. Altenbach, and T. L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission, Arkansas, USA. 64pp.

Higgins, K. F., E. Dowd Stukel, J. M. Goulet, and D. C. Backlund. 2000. Wild mammals of South Dakota. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA. 278pp.

Hutchinson, J. T., and M. J. Lacki. 2000. Selection of day roosts by red bats in mixed mesophytic forests. Journal of Wildlife Management 64: 87-94.

Jones, J. K., and J. R. Choate. 1978. Distribution of two species of long-eared bats of the genus *Myotis* on the Northern Great Plains 10: 49-52.

Jones, J. K., and H. H. Genoways. 1967. Annotated checklist of bats from South Dakota. Transactions of the Kansas Academy of Sciences. 70: 184-196.

Jones, J. K., D. M. Armstrong, and J. R. Choate. 1985. Guide to mammals of the Plains states. University of Nebraska Press, Lincoln, Nebraska, USA. 371pp.

Kunz, T. H. 1973. Resource utilization: temporal and spatial components of bat activity in central Iowa. Journal of Mammalogy 54: 14-32.

Kunz, T. H. 1982. *Lasionycteris noctivagans.* Mammalian Species 172: 1-5.

Kunz, T. H., and R. A. Martin. 1982. *Plecotus townsendii.* Mammalian Species 175: 1-6.

Kurta, A., and R. H. Baker. 1990. *Eptesicus fuscus.* Mammalian Species 356: 1-10.

Manning, R. W., and J. Jones, Jr. 1989. *Myotis evotis.* Mammalian Species 329: 1-5.

Mattson, T. A., and M. A. Bogan. 1993. Survey of bat roosts in the southern Black Hills in 1993. Jewel Cave National Monument unpublished report. 20pp.

Mattson, T. A. 1994. Distribution of bats, and the roosting ecology of the silver-haired bat *(Lasionycteris noctivagans)* in the Black Hills of South Dakota. M.S. Thesis. University of Wyoming, Laramie, Wyoming, USA. 60pp.

Mattson, T. A., S. W. Buskirk, and N. L. Stanton. 1996. Roost sites of the silver-haired bat *(Lasionycteris noctivagans)* in the Black Hills, South Dakota. Great Basin Naturalist 56: 247-253.

Nagorsen, D. W., and R. M. Brigham. 1993. Bats of British Columbia. University of British Columbia Press, Vancouver, British Columbia, Canada. 164pp.

Nowak, R. M., and J. L. Paradiso. 1983. Walker's mammals of the world (4^{h} edition). Johns Hopkins University Press, Baltimore, Maryland, USA. 568pp.

Nowak, R. M. 1999. Walker's mammals of the world ($6^{`1}$ edition). Johns Hopkins University Press, Baltimore, Maryland, USA. 1936pp.

NSE (NatureServe Explorer). 2002. NatureServe Explorer: an online encyclopedia of life homepage. http://www.natureserve.ori4/explorer/ 23 Dec 2002.

O'Farrell, M. J., and E. H. Studier. 1980. *Myotis thysanodes.* Mammalian Species 137: 1-5.

Over, W. H., and E. P. Churchill. 1945. Mammals of South Dakota. University of South Dakota, Vermillion, South Dakota, USA. 56pp.

Pearson, O. P., Koford, M. R., and A. K. Pearson. 1952. Reproduction of the lump-nosed bat *(Corynorhinus raftnesquei)* in California. Journal of Mammalogy 39: 150.

Pierson, E. D., M. C. Wackenhut, J. S. Altenbach, P. Bradley, P. Call, D. L. Genter, C. E. Harris, B. L. Keller, B. Lengus, L. Lewis, B. Luce, K. W. Navo, J. M. Perkins, S. Smith, and L. Welch. 1999. Species conservation assessment and strategy for Townsend's big-eared bats *(Corynorhinus townsendii townsendii* and *Corynorhinus townsendii pallescens):* Idaho conservation effort. Idaho Department of Fish and Game, Boise, Idaho, USA. 67pp.

SDBWG (South Dakota Bat Working Group). 2002. Bats found in South Dakota homepage. http://nat hist.sdstate.edu/SDBWG/SDBWG.html 8 April 2002.

SDGFP (South Dakota Department of Game, Fish and Parks). 2002. Rare, threatened or endangered animals tracked by the South Dakota Natural Heritage Program homepage. http://www.state.sd.us/gfi)/Diversity/RareAnimal.htm #MAMMALS 15 March 2002.

Shump, K. A., and A. U. Shump. 1982a. *Lasiurus borealis.* Mammalian Species 183: 1-6.

Shump, K. A., and A. U. Shump. 1982b. *Lasiurus cinereus.* Mammalian Species 185: 1-5.

Stebler, A. M. 1939. An ecological study of the mammals of the Badlands and the Black Hills of South Dakota and Wyoming. Ecology 20: 382-393.

Swier, V. J. 2003. Distribution, roost site selection, and food habits of bats in eastern South Dakota. M.S. Thesis. South Dakota State University, Brookings, South Dakota, USA. 105pp.

Tigner, J., and E. Dowd Stukel. 2003. Bats of the Black Hills: a description of status and conservation needs. South Dakota Department of Game, Fish and Parks, Wildlife Division Report 2003-05, Pierre, South Dakota, USA. 94pp.

Tigner, J., and W. C. Aney. 1993. Report of the northern Black Hills bat survey. Black Hills National Forest unpublished report, Spearfish, South Dakota, USA. l6pp.

TPW (Texas Parks and Wildlife). 2001. Nature: species accounts of bat homepage. http://www.tpwd.state.tx.us/nature/wild/mammals/bats/species/index.htm 14 December 2000.

Turner, R. W. 1974. Mammals of the Black Hills of South Dakota and Wyoming. University of Kansas, Lawrence, Kansas, USA. 178pp.

van Zyll de Jong, G. G. 1985. Handbook of Canadian mammals 2: Bats. National Museum of Canada, Ottawa, Canada.

Vonhof, M. J. 1996. Roost-site preferences of big brown bats *(Eptesicus fuscus)* and silver-haired bats *(Lasionycteris noctivagans)* in the Pend D'Oreille Valley in souther British Columbia. Pages 62-80 *in* Barclay, R. M. R., and Brigham, R. M., editors. Bats and forests symposium: October 19-21, 1995, British Columbia Ministry of Forests, Victoria, British Columbia, Canada.

Warner, R. M., and N. J. Czaplewski. 1984. *Myotis volans.* Mammalian Species 224: 1-4.

Watkins, L. C. 1972. *Nycticeius humeralis.* Mammalian Species 23: 1-4.

Whitaker, J. 0., C. Maser, and S. P. Cross. 1981 *a.* Foods of Oregon silver-haired bats, *Lasionycteris noctivagans.* Northwest Science 55: 75-77.

Whitaker, J. 0., C. Maser, and S. P. Cross. 1981 b. Food habits of eastern Oregon bats, based on stomach and scat analysis. Northwest Science 55: 281-292.

Williams, L. M., and M. C. Brittingham. 1997. Selection of maternity roosts by big brown bats. Journal of Wildlife Management 61: 359-368.

Wilson, D. E., and S. Ruff. 1999. Smithsonian book of North American mammals. Smithsonian Institution Press, Washington, DC. 750pp.

Worthington, D. 1992. Methods and results of a census of bats in Jewel Cave on December 16, 1992. Jewel Cave National Monument unpublished report. 3 pp.