Final Report
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Project Title: Natural History and Abundance of Whip-Poor-Wills and Insectivorous Bats in Southeastern South Dakota.

By C. Loren Buck, Jeff Lane, Jennifer L. Jenkins, Daniel T. Schlueter & R. Mark Brigham

The objectives of this project were to:

Whip-poor-wills

1) Document occurrence and estimate population size of Whip-poor-wills based on call counts.
2) Measure reproductive effort and success by tracking birds to nest sites.
3) Assess habitat use to determine if Whip-poor-wills are restricted to remnant bottomland riparian woodlands.
4) Determine if Whip-poor-wills in this region use torpor as a means to reduce energy expenditure and, if so, under what environmental conditions.

Insectivorous Bats

5) Assess sex ratio, migratory timing and reproductive activity.
6) Conduct general habitat survey using acoustic monitoring.

Introduction

Whip-poor-wills— The cryptic plumage and nocturnal behavior of the Caprimulgidae (Whip-poor-wills, Goatsuckers, Nightjars) has precluded all but anecdotal studies addressing even their basic biology. Thus little is known of their population size, breeding success, and habitat use. Indeed, the only way to accurately assess these parameters is to outfit birds with radio-transmitters and locate individuals on a semi-continuous basis. As a consequence of outfitting Whip-poor-wills (*Caprimulgus vociferus*) with temperature sensitive radio-transmitters, we were able to contemporaneously assess body temperature and location of individual Whip-poor-wills to address questions regarding their basic natural history including their use of torpor.

Due to the secretive nature of Whip-poor-wills and other nightjars, population size estimates are typically conducted through the use of call counts (e.g. Cadbury 1981; Cooper 1981). To date, no work has been conducted on this species in southeastern South Dakota; hence the first objective of our study was to use a combination of call counts and mist-netting to estimate population size of Whip-poor-wills at the northern limit of their western range near Vermillion, SD.

Whip-poor-wills in southern Ontario lay one clutch of two eggs each year, and the laying of is synchronized with the lunar cycle (Mills 1986). It is hypothesized that the timing of laying synchronizes the 2 weeks prior to fledging with the period of most intense moonlight. Thus, when energetic demands of the young are highest, parents have maximal time for foraging (Mills 1986). However, ecologically and taxonomically similar Common Poorwills (*Phalaenoptilus nuttalli*) typically lay two clutches per year, and these clutches are not correlated with the lunar cycle (Brigham and Barclay 1992). Dean *et al.* (1995) reported the first nesting record of Whip-poor-wills in South Dakota and suggested that this clutch, unlike those in southern Ontario, was not synchronized with the lunar cycle. Our second objective, therefore, was to assess the reproductive chronology and success of Whip-poor-wills in southeastern South Dakota. Depending upon the reproductive strategy used, the implications for population growth for this species could be considerable.

The use of call counts to assess population sizes of Whip-poor-wills and other species precludes an in-depth analysis of habitat use. The few anecdotal reports addressing habitat use characteristics of this species suggest that mixed wood forests with large amounts of edge are preferred (Hamel *et al.* 1978; Bjorklund and Bjorklund 1983). Nests are typically found on bare ground with a cover of dead leaves or pine needles (Street 1956). In southeastern South Dakota, it is possible that Whip-poor-wills will be restricted to the remnant riparian woodlands along the Missouri River.

Regarding the physiological ecology of this species, we had good reason to suspect that they might use torpor for both ecological and taxonomic reasons. This region of South Dakota experiences summers that are short and nights that can be cool particularly early in the breeding season and prior to migration. In addition, Whip-poor-wills are ecologically similar to caprimulgids which use torpor in that they forage by sallying (Mills 1986). There is also evidence that similarly sized free-ranging Common Poorwills (Brigham 1992; Csada and Brigham 1994) and Australian Owlet-nightjars (*Aegotheles cristatus*; Brigham *et al.* 2000) use torpor in areas with relatively benign climates. Furthermore, there are laboratory data that show that congeneric, but large (80g), European Nightjars (*Caprimulgus europeaus*) can lower T_b in response to low ambient temperatures (Peiponen 1966). These observations lend support to the prediction that Whip-poor-wills may use torpor as a strategy to conserve energy (Prothero and Jurgens 1986). There is, however, evidence suggesting that torpor may not be used by Whip-poor-wills, including skin temperatures (T_{sk}) collected from a few Whip-poor-wills roosting in Ontario (Hickey 1993).

Tree Roosting Bats— Until this study, virtually no work had been conducted, even a basic inventory, on the Chiroptera in the eastern part of South Dakota (Stukel and Backlund, 1997). Studies of insectivorous bats roosting in anthropogenic sites have indicated that bat populations are probably limited by adequate roosting opportunities rather than prey availability (Humphrey 1975). Although it is likely that the woodland remnants along the Missouri River near Vermillion represent some of the best remaining natural bat habitat in SE South Dakota, studies of natural history, distribution, abundance, roosting sites and foraging patterns of bats that inhabit natural woodlands have not been undertaken.

Previous studies have indicated that during the summer months females are more common in lowland areas with high insect abundance, likely due to the high energy demands of the lactation (Grindal *et al*. 1999). Whether this phenomenon holds in southeastern South Dakota was assessed by recording the sex of all of the bats caught in mist-nets. Additionally, we monitored reproductive status of females (i.e. non-reproductive, pregnant, or lactating) and monitored when the first volant young of the year are captured. In conjunction with the mist-netting, we assessed general habitat use and timing of fall migration with an ultrasonic detectors that translate the high frequency of the bats' echolocation calls to a frequency audible to humans.

Materials and Methods

Whip-poor-wills— In order to determine whether or not Whip-poor-wills use torpor and to provide location data, birds were captured and outfitted with external temperature sensitive radio-transmitters. Birds were captured in mist nets within Clay County State Park, Union County State Park and at the SE edge of Frost Wilderness State Game Production Area which lies adjacent to the Vermillion Airport. All of these sites except Union County State Park are riparian woodlands of the Missouri River. Union County State Park is non-riparian remnant woodland. Research efforts were concentrated to a subsection of each of the previously mentioned areas which included about 37.5 ha of Clay County State Park, 12.5 ha of Union County State Park and 10 ha lying adjacent to the SE edge of Frost Wilderness State Game Production Area (henceforth the Airport Site).

The project began in early May 2000. At this time Whip-poor-wills had been present at the site for likely 2 weeks (South Dakota Ornithologist's Union, 1991). Logistic constraints prevented earlier commencement. Within each study site, we scouted and flagged with surveyors tape areas where Whip-poor-wills were reliably heard (several consecutive nights) and where mist nets could be set. We observed that birds were more active and made foraging trips more often along the woodland fringes and in the less dense foliage; therefore, nets were generally erected on the fringe of a forest or along cleared trails within the study site. Setting nets in these locations also reduced entanglement with the dense riparian vegetation. Whip-poor-will activity peaked approximately 15 min. after twilight and typically we had the nets erected on site approximately 1 hour prior to peak activity so as to not interrupt their normal behavior. Initially, multiple birds were targeted for capture simultaneously on each night with 5 mist nets. All were 30mm 4 shelf nets raised to approximately 3 m in height. Three were 12 m, 1 was 18 m & 1 was 8 m in length. We initially distributed the nets at 2 or 3 different locations within one site (e.g. within Clay County State Park on 1 night we would set 3 nets at one location and 2 nets at the other). After experimenting with a variety of net arrangements, we found it most effective to saturate a designated area within a site with 5 mist nets in a box configuration to target one bird. In total, we targeted capture of Whip-poor-wills on 57 nights throughout the summer.

To lure birds into nets we used playbacks of territorial males placed behind the mist nets. Upon hearing the playback tape within their territory, targeted birds would approach to within 3 meters of the tape player where they would typically perch and call aggressively for an average of 2 to 3 minutes. Subsequently, they would cease calling and fly toward the tape player located at the center of the box-configuration of the nets so as to increase the chance of a bird contacting a net. Birds were far more responsive to the callback in May and early June than in the remainder of the season. By mid-late July when reproductive activity had ceased (Mills 1986), until the end of the season, birds tended to not respond by flying toward the playback at all. Whip-poor wills were also captured opportunistically by contacting a net on their usual flight paths. It is likely that all females were captured in this manner.

Captured birds were extracted from the net and rolled-up in cloth bags in order to reduce the potential for self-injury. We measured and recorded their body mass and wingspan and determined age (adult or juvenile) and sex. Finally, a 2.3g temperature sensitive radio-transmitter was affixed to the bird. Transmitters were attached backpack-style and fit between the scapulae. Because these transmitters are external, they provide a measure of skin temperature (T_{sk}), which has been found to reliably parallel body temperature (T_b; Brigham 1992; Brigham *et al.* 2000). Transmitters emit a signal with a pulse rate proportional to the animal's T_{sk} (pulse rates are faster with an increase in T_{sk} and slower with a decrease in T_{sk}) that can be received from a distance of approximately 1-2 km depending upon the terrain. Based on subsequent observations of birds in the field, the transmitters had no apparent negative effect on the bird's ability to fly. In 1 instance, however, a bird died during the study due to complications arising from the harness. A broken string on the transmitter backpack resulted in an entangled wing.

Skin temperature readings for all birds were taken nightly from 9 p.m. to 6 a.m. at half-hour intervals from the date of capture to either signal loss, thrown transmitter, death, or migration. By mid September, only 4 of the original 12 birds were on site with transmitters and T_{sk} readings were taken less frequently averaging 2-3 times per week from 10 p.m. to 2 a.m. at 1/2 hour intervals. In addition, a single reading was taken at 4 a.m. approximately 5 days per week. Skin temperature was calculated by measuring the time required to receive 10 pulses from the transmitter. This was completed 3 times in series per bird. The average of the 3 readings was converted to a temperature using pre-calibrated curves supplied by the manufacturer.

Call counts were conducted on a sample of nights at all study sites. This form of census is well employed when determining the population size of nightjars (e.g. Cadbury 1981; Cooper 1981). Since territories remained constant throughout the season (with the exception of the Union County site, explained below) we are confident that our census reflect the accurate numbers of a relatively stable population. At Union County 6 birds were heard calling early in the season and two birds were caught, 1 on May 29 and 1 on May 30. However, by June 11 both birds with transmitters had left the site and could not be relocated and no birds were heard calling for the duration of the study period. The cause(s) of this emigration are unknown.

Nest searches were employed weekly for birds that had been outfitted with radio-transmitters. When a nest was located, the vegetative characteristics were recorded, as was the number of young, and the incubation behavior of the parents.

In addition to field measurements of body temperature, three males were captured in mid July and transported to the laboratory at the University of South Dakota where they were measured for metabolic rate (MR). The birds were held at room temperature and provided with water ad libitum. Metabolic trials were conducted on the following day. Birds were transferred to respirometry chambers where metabolic trials were conducted following the procedure of Cooper and Swanson (1994). Briefly, the respirometry chamber used was a 3.8-liter metal can equipped with a perch and painted black on the inner surface to maximize emmissivity. The chamber with the bird was lowered into a temperature-controlled circulating bath of water and ethylene glycol (accurate to ± 0.5°C). Following submersion, the chamber was allowed a temperature equilibration period of at least 60 min. at each of the 3 designated temperatures (30, 15, and 0°C). Dry, carbon dioxide-free air leaving the respirometry chamber was measured for oxygen content with a single-channel oxygen analyzer (Ametek Applied Electrochemistry S-3A) every 60 sec and MRs were estimated as the minimum mean rate of oxygen consumption for a 10 min interval within the 60-min evaluation period (Hill 1972, Eq. 2). Chamber temperature was also recorded each 60 s. Five daytime measurements (3 at 30°C, 1 at15°C, and 1 at 0°C) were made at approximately 14:00 on the first day following capture and four nighttime measurements (2 at 15°C and 2 at 0°C) were made at 23:00 of that evening. At the end of each trial, the bird was promptly removed from the chamber and cloacal temperature was recorded using a thermocouple thermometer (Cole-Parmer, Model 8500-40). Birds were released at their site of capture directly following the metabolic measurements.

Tree Roosting Bats— By virtue of our raised mist nets, bats were opportunistically captured within the area described for Clay County State Park and the Airport site. In total, nets were open and there was a potential for opportunistic captures for 481.25 net-hours. Bats were captured most often well after dark when Whip-poor-will activity had decreased. Opportunistic captures of bats were limited because the mist net locations were chosen to maximize the likelihood of Whip-poor-will captures.

In addition to opportunistic captures, we also targeted capture of bats for a total of 256 net-hours at the Myron Grove river access (0.5 ha), Cotton Park (4.0 ha, near Vermillion, SD), Union County State Park and a 200 m swath of riparian woodlands of the Big Sioux River on the South Dakota/Iowa border. At these sites, we distributed 3 to 5 mist nets along anticipated flight paths such as foliage tunnels created by overhanging tree branches and along river edges where there was a high abundance of flying insects.

Captured bats were extracted from nets in a similar fashion to that of Whip-poor-wills. Bats were removed from the nets and held in cloth bags until transferred to the nearby research vehicle for measurement. The following data were collected: location of capture, time, sex, reproductive status, species, mass, and forearm length. All bats were released at the site of capture immediately following data collection.

Peak activity of bats was determined on a sample of nights by using a bat detector (Anabat II, Titley Electronics, Australia). The detector was pointed straight up in a clearing, near a woodland (e.g. in parking lots) at both the Myron Grove River access (8 nights) and Cotton Park (1 night). The detector was placed at the same spot within each site to minimize spatial variability. We recorded the number of calls from 9 p.m. to 6 a.m. at 30-min intervals for a 5-min duration. Although this procedure does not allow for discrimination between one bat producing multiple calls and multiple bats producing separate calls, it does give an indication of general levels of activity. No attempt was made to identify bats to species based on calls, as this technique has proven to be unreliable in previous studies (Barclay *et al*. 1999). In addition to providing indices of general activity, acoustic monitoring also allowed us to determine when bats left the site for fall migration.

Results and Discussion

Whip-poor-wills—A total of 12 birds (10 males and 2 females) were captured and outfitted with radio-transmitters. All captures occurred between 21:30 and 23:00. Ten of the 12 birds captured were male (9 adult, 1 juvenile) and 2 were female. It is likely that we captured more males because they are more aggressive in their territories than are females (Mills 1986). Adult males and females did not significantly differ in mass (males = 54.44 ± 4.8 g; females = 58.25 ± 2.33; $P > 0.05$) or wingspan (males = 42.8 ± 4.2cm; females = 44.4 ± 1.1 cm; $P > 0.05$; Figure 1). The heaviest Whip-poor-will captured was an adult male that weighed 64.1 g and the lightest was a juvenile male that weighed 44.6 g.

Based on call counts, birds were most abundant in Clay County state park (13 males), followed by Union County state park (6 males) and the Airport Site (4 males). Although these values represent calling territorial males, the opportunistic capture of two females implies that both sexes were present.

We captured the majority of the birds at Clay County State Park, an area of remnant riparian woodlands of the Missouri River. The area is dominated by a cottonwood (*Populus deltoides*) overstory and an understory of rough leaved dogwood (*Cornus drummondii*) and prickly ash (*Zanthoxylum americanum*). Posion ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*) comprise the herbaceous layer (Dean *et al*. 1995). We also captured birds at the Airport site. This area, too, is remnant riparian woodland of the Missouri River and has a similar vegetative structure. We also captured 2 birds in Union County State Park. This area, though transected by the small Brule River, is more accurately described as an upland woodland. Therefore, our original prediction of birds being restricted to the remnant riparian woodlands of the Missouri River was not borne out by the data.

We obtained 2 indications of reproductive activity. Firstly, our nest searches resulted in discovery of the second recorded Whip-poor-will nest in South Dakota on June 10, 2000. Only one young was observed, but it is possible that another was under cover. Upon approaching the nest, the male, who was incubating, flushed. It has been reported that this behavior can result in chicks separating, seemingly to reduce individual predation risk (Dyer 1977). The nest area consisted of a small clearing (0.75m diameter) in the poison ivy herbaceous layer. The young was cinnamon-colored and perfectly camouflaged with the underlying layer of dead leaves and twigs. Our second piece of data indicating reproductive activity was the capture of the volant male on July 7, 2000. The male, as stated, was marginally smaller and weighed less than the adult males, and retained some of its cinnamon-colored plumage. Its capture in a known territory of another male indicates that it was likely the offspring of that male and had yet to disperse. Furthermore, the juvenile was not caught through use of the playback tape, but instead as an opportunistic capture when the tape was not playing. During 2001, we plan to employ further nest searches to develop a more general picture of the reproductive schedule of Whip-poor-wills and to ascertain whether Whip-poor-wills in South Dakota synchronize their reproduction with the lunar cycle.

All birds remained euthermic throughout the summer months (i.e. $T_{sk} \geq 30°C$). However, beginning in September until migration in early October, radio-tagged birds displayed a positive linear correlation between T_a and T_{sk} ($P < 0.05$; Figure 2). This positive correlation is mainly due to a profound decrease in T_{sk} at the lowest T_a. At T_a's of <10°C 2 of the 4 radio-tagged birds displayed torpor; T_{sk} dropped to 26 and 25°C at T_a's of 9.1°C and 8.5°C, respectively.

Average oxygen consumption of Whip-poor-wills in the laboratory did not differ between daytime and nighttime measures ($P > 0.05$) and averaged 0.961, 1.72, and 2.96 ml O_2 min^{-1} at chamber temperatures of 30, 15, and 0°C, respectively (Figure 3). No differences in MRs were apparent among the 3 birds tested at any of the chamber temperatures tested. Mean MR at 30° (within the thermal neutral zone) was 88% of predicted MR for a 45g nonpasserine (Aschoff and Pohl 1970). A lower than average basal MR is consistent with published data for other caprimulgid birds (Bartholomew *et al*. 1957). However, MR at 0°C was 3.1 times greater than basal MR suggesting this species is poorly insulated, and thus supports the hypothesis that these birds may need to employ torpor when exposed to low environmental temperatures. The increase in MR with decreased T_a indicates that birds were raising their MR to defend euthermic body temperatures rather than decreasing thermal conductance by decreasing T_b and entering torpor.

In conclusion, field measurements of body temperature demonstrate that Whip-poor-wills use shallow torpor at least in late summer and early fall prior to migration, but only when ambient temperatures are less than about 10°C. Although Whip-poor-wills may be capable of entering torpor in the spring and summer months, T_a's remained continuously well above 10°C from May - August of 2000. In the 2001 field season, we plan to begin monitoring T_{sk} of free-living Whip-poor-wills earlier in spring (beginning in April) upon first arrival of birds to the Vermillion area. At this time of year temperatures historically drop to well below 10°C and abundance of flying insects is considerably lower than in summer or fall. It is likely that birds during this time will show torpor and perhaps to a greater extent than in the fall. Whip-poor-wills did not show torpor in the laboratory, but did support their potential need for a means of energy conservation in periods of low T_a and insect abundance. In 2001, MR trials will be coupled with food restrictions to attempt to induce torpor.

Tree Roosting Bats— Bats were observed at all of the sites at the commencement of the study indicating that spring migration was previous to May 4. During the study, most bats were captured within Myron Grove river access with additional captures at Clay County State Park, the Airport Site, and Cotton Park. Peak activity of bats, as evidenced by the acoustic monitoring (Figure 4), was at approximately 10:30 p.m. for July, August, and September (Figure 4). General activity decreased dramatically through September and ceased in early October. No echolocation calls were recorded on consecutive nights after the first week of October suggesting that bats had migrated from the Vermillion area within that week.

A total of 60 bats of seven different species, were captured. Based on captures, *Eptesicus fuscus* were the most abundant followed by *Myotis septentrionalis, M. lucifugus, Lasiurus borealis, L. cinereus, Lasionycteris noctivagans*, and *Nyticeius humeralis*. The bats we had predicted to be likely or possibly caught based on their broad geographical distributions (Jones *et al*. 1983) are shown in Table 2.

L. cinereus were the largest with respect to body mass (24.9g) and forearm length (53.9 mm), followed by *E. fuscus* and *L. borealis*. *L. noctivagans* and *Nyticeius humeralis* had nearly equivalent body masses and forearm lengths. Finally, *M. lucifugus* and *M. septentrionalis* were the smallest of the bats captured, sharing nearly equivalent sized features (Table 1). In addition, *N. humeralis* was recorded for the first time in southeastern South Dakota.

Male *E. fuscus* were more caught more frequently than females (62.5% Male, 37.5% Female), *M. septentrionalis* (53.3% Male/ 46.7% Female), and *M. lucifugus* (57% Male/ 43% Female). Both of the *L. noctivigans* caught were male, while both *N. humeralis* were female. An equal number (2) of each sex of *L. cinereus* were caught, and more female than male *L. borealis* were caught (80% Female, 20% Male).

The dates that the first volant young of each species captured are indicated in Table 3. No pregnant or lactating females were captured, however this is not surprising considering the overall low capture rate of females relative to males. During July 17 and August 22 a nearly equal proportion of bats captured were juveniles and adults (51% Juvenile, 49% Adult). This ratio is likely attributable to the lack of flying experience of the young, rather than a true frequency distribution.

The importance of riparian habitat for insectivorous bats in southeastern South Dakota is indicated by the relatively high capture rate and acoustic activity in this habitat. Myron Grove River Access had the highest capture rate (0.24 bats/net hour) followed by Cotton Park (0.06 bats/net hour). The one site that is not remnant riparian woodland (Union County State Park) did not yield any captures (opportunistic or targeted), and qualitative acoustic monitoring suggested that bats were less common in this area than the riparian sites. During 2001 we plan to quantitatively determine the importance of intact riparian habitat to bats by netting and acoustic sampling in both an undisturbed and a recently disturbed site.

In conclusion, a number of notable results arose from the insectivorous bat survey. First, clearly the bat fauna in southeastern South Dakota is dominated by *E. fuscus*. This species represented over 40% of all of the bats captured. This species is common and widespread throughout much of North America (van Zyll de Jong 1985) and is known to be able to acclimate well to anthropogenic sites (Nagorsen and Brigham 1993). Thus, the combination of roosting opportunities in the town of Vermillion and the riparian woodlands likely represents an ideal combination of habitats for this species. A further finding was that for 4 species, and for the overall number of bats captured, females appeared to be more abundant than males. This is in support of previous studies that have indicated that increased energic demands of females with young cause them to be more prevalent in lowland foraging habitats than males (Grindal *et al.* 1999). Lastly we captured 2 *N. humeralis*. This species typically inhabits more southern latitudes and has never before been recorded in South Dakota. The capture of two individuals further suggests that this species is indeed present in southeast South Dakota and that the captured bats were not accidental vagrants. During 2001, more sampling will allow us to further investigate the status of this species in South Dakota.

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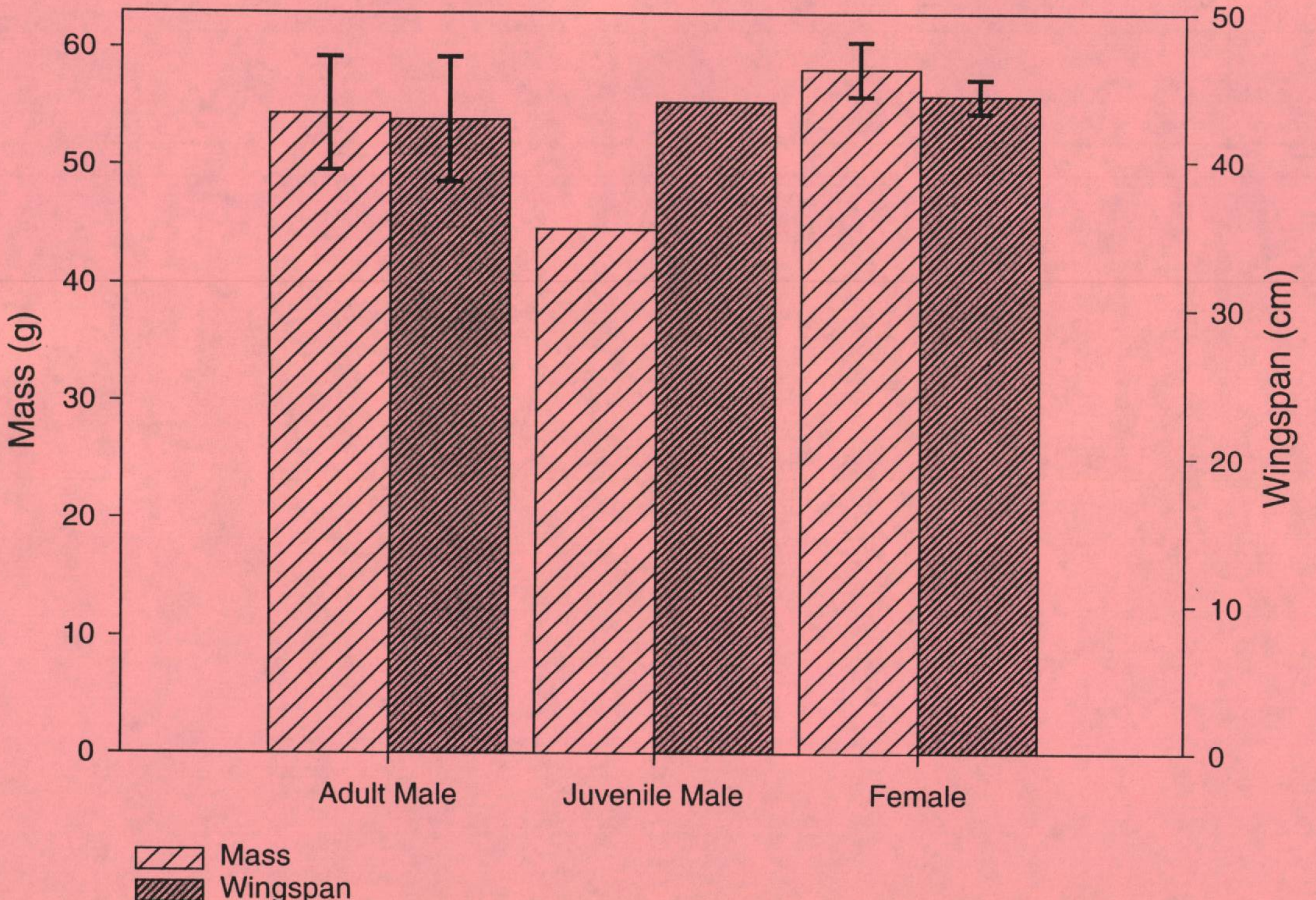

Figure 1. Means ± *SE* of wingspan and mass for eight adult male, one juvenile male, and two female Whip-poor-wills captured from May 7th to June 28th 2000 near Vermillion, SD.

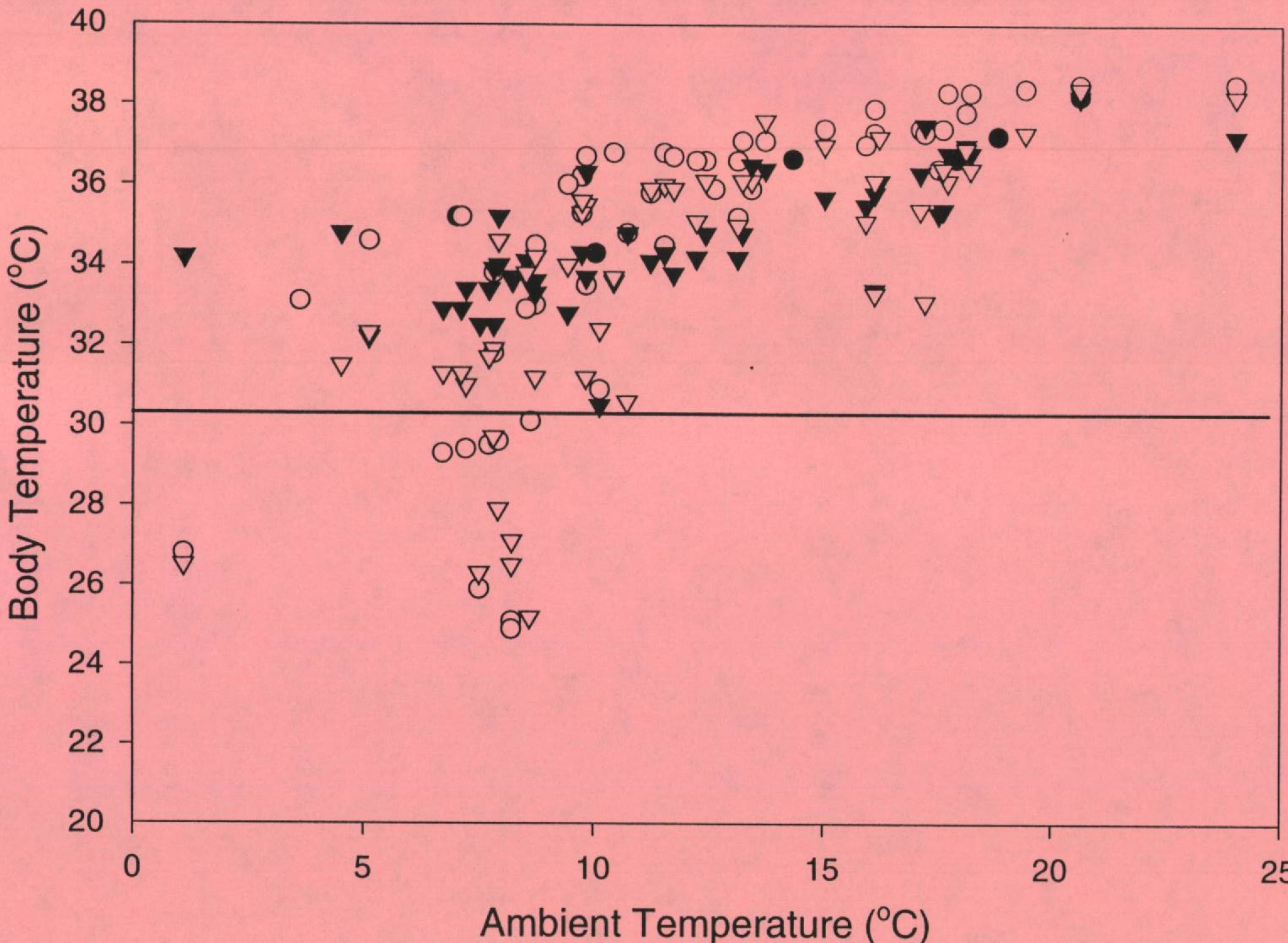

Figure 2. Body temperature of four free-living Whip-poor-wills collected between 23:00 and 2:00 in September 2000 near Vermillion, SD. Individuals are desinated by different symbols.

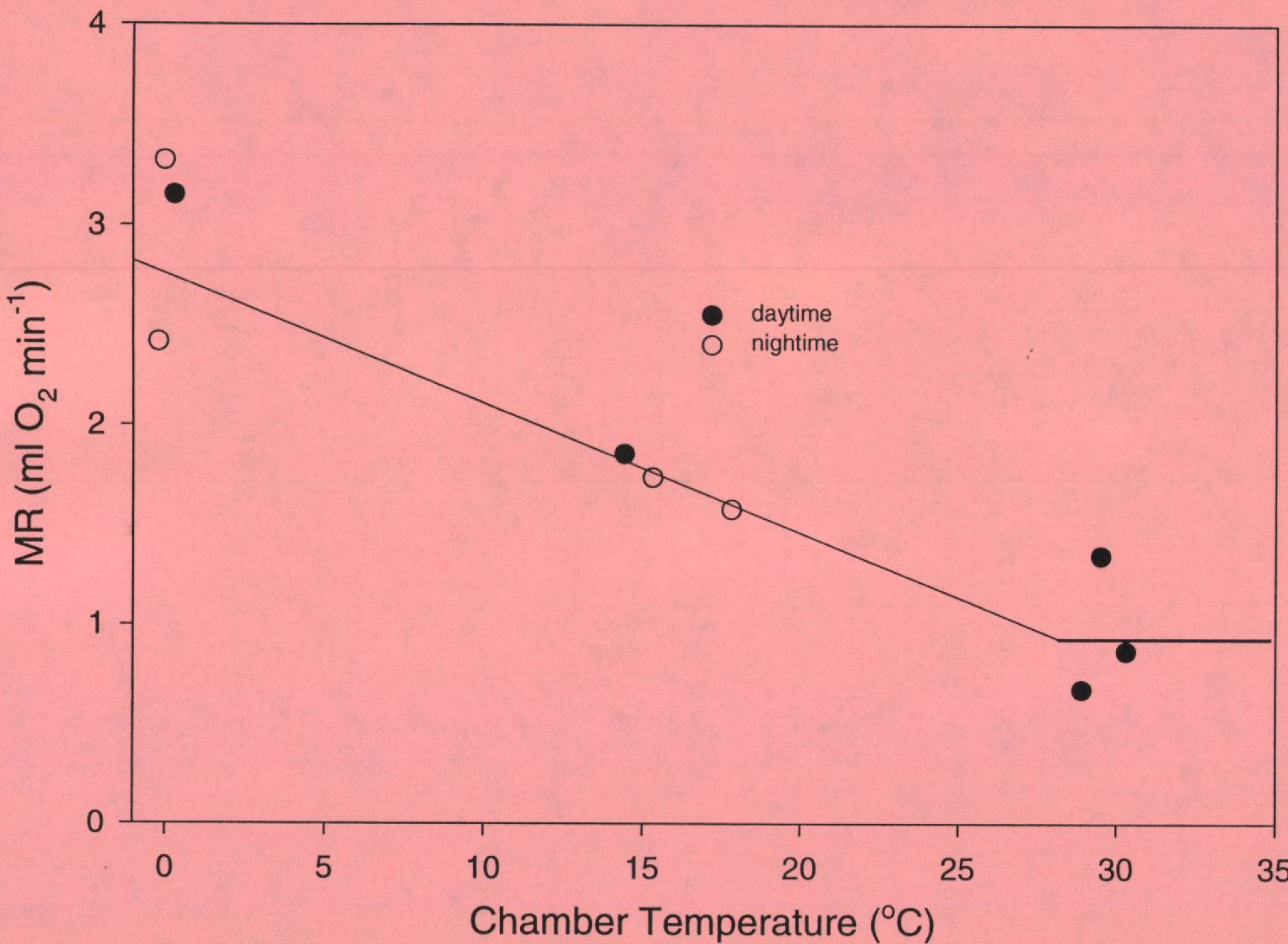

Figure 3. Effect of Ta on MR measured as a rate of O_2 consumption of 3 Whip-poor-wills. Solid circles represent daytime measures (14:00) and open circles represent night time measures (23:00).

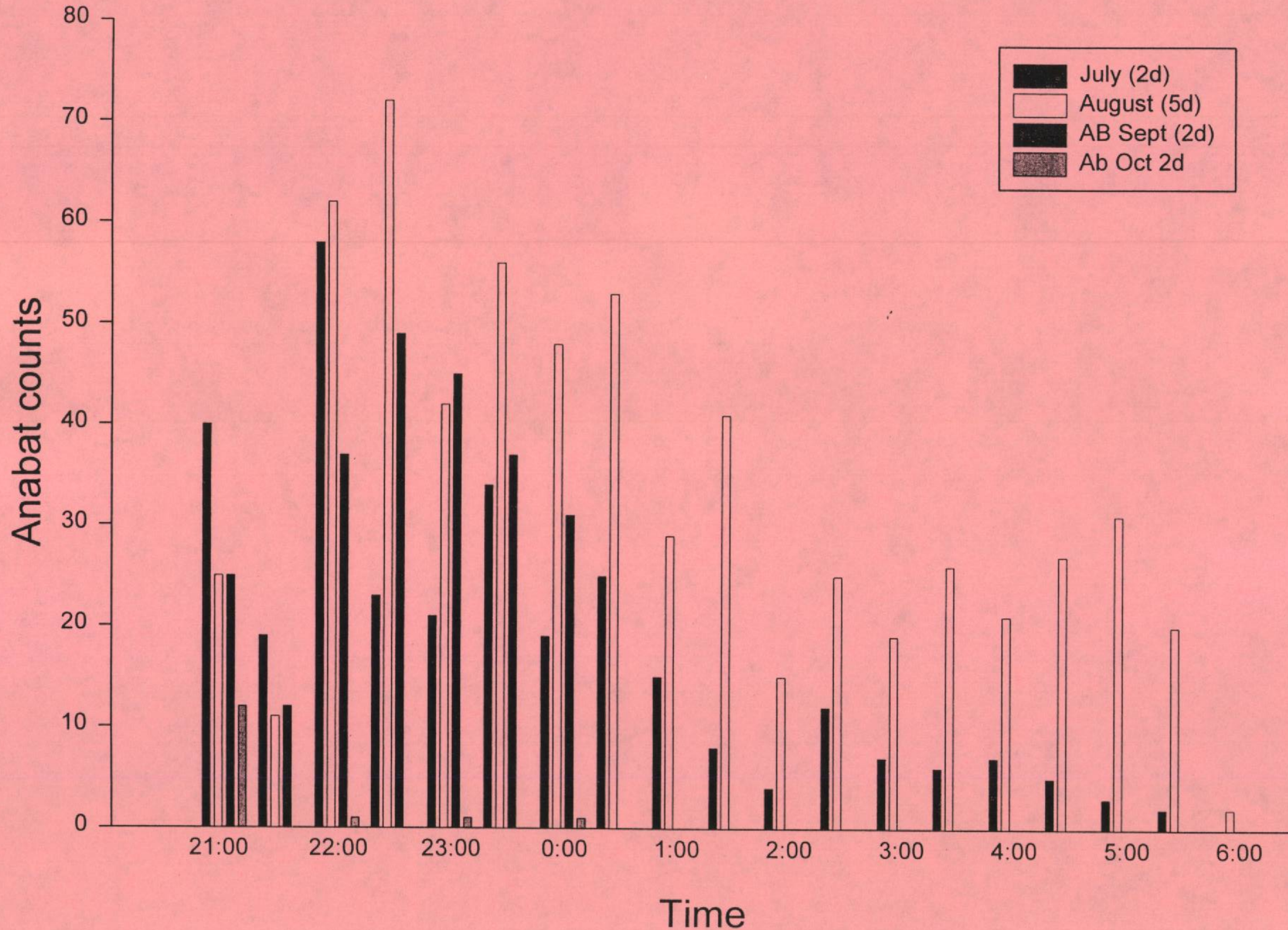

Figure 4. Multiday averages of number of bat calls recorded between 21:00 and 6:00 (per 5-min interval).

Table 1. Total captures, mean mass, and forearm length for tree roosting bats in southeastern South Dakota.

Species	Total Captures	Mass (g)	Forearm Length (mm)
Eptesicus fuscus	24	16.40	45.40
Myotis lucifugus	7	6.20	34.30
Myotis septentrionalis	16	6.70	35.10
Nyticeius humeralis	2	10.00	36.10
Lasiurus borealis	5	12.35	41.38
Lasionyctens noctivagans	2	10.90	40.90
Lasiurus cinereus	4	24.90	53.90

Table 2. Tree roosting bats predicted as being likely or possibly caught in southeastern South Dakota (based on Jones *et al.* 1983). ** Indicates whether species was actually caught in the 2000 species survey

Species	Likely/Possibly
Eastern small-footed bat Myotis leibii	Likely
Little brown bat *Myotis lucifugus*	Likely **
Long-legged bat *Myotis volans*	Likely
Northern long-eared bat *Myotis septentrionalis*	Likely **
Silver-haired bat *Lasionycteris noctivagans*	Likely **
Big brown bat Eptesicus fuscus	Likely **
Red bat *Lasiaurus borealis*	Likely **
Hoary bat *Lasiaurus cinereus*	Likely **
Western long-eared bat *Myotis evotis*	Possibly
Fringed bat *Myotis thysanoides*	Possibly
Eastern pipistrelle *Pipistrellus subflavus*	Possibly
Evening bat *Nyticeius humeralis*	Possibly **
Townsend's big-eared bat *Corynorhinus townsendii*	Possibly
Mexican free-tailed bat *Tadarida brasiliensis*	Possibly

Table 3. Dates of capture of the first volant young for each species of tree roosting bats in southeastern South Dakota.

Species	Date of capture of first volant young in 2000
Eptesicus fuscus	July 17
Myotis lucifugus	No volant young captured
Myotis septentrionalis	July 27
Nyticeius humeralis	August 22
Lasiaurus borealis	August 1
Lasiaurus noctivagans	July 17
Lasiaurus cinereus	August 1