



OCCASIONAL PAPERS

DISTRIBUTIONAL AND REPRODUCTIVE RECORDS OF BATS FROM SOUTH-CENTRAL NEBRASKA

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ABSTRACT

Bats are facing unprecedented population declines across North America. Onset and continued westward movement of white-nose syndrome (WNS) has caused large-scale mortality in cave-dwelling, hibernating eastern species of bats, whereas numerous migratory bat species are affected by wind-energy facilities across the continent. To date, limited natural history data are available for bats from south-central Nebraska, an area of the state not yet impacted by WNS or wind-energy facilities. Herein, we report on geographic and reproductive records of bats from the region to better understand them and to serve as a baseline on species occurrences and their natural history. We documented 22 county records of seven species from 12 total counties, including expansion of distributional limits for the Northern Long-eared Myotis (*Myotis septentrionalis*), Evening Bat (*Nycticeius humeralis*), and American Perimyotis (*Perimyotis subflavus*) in the state. Fifteen reproductive records were documented from four species in nine counties, including the earliest volant young for Eastern Red Bats (*Lasiurus borealis*) and latest date of pregnancy for Evening Bats in Nebraska. Understanding the natural history and distribution of bats in the region will help to make informed management decisions in the future.

Key words: American Perimyotis, distribution, Evening Bat, *Myotis septentrionalis*, Nebraska, Northern Long-eared Myotis, *Nycticeius humeralis*, *Perimyotis subflavus*, range expansion, reproduction

INTRODUCTION

Bats are facing unprecedented population declines in North America for both hibernating and migratory species (Cryan and Barclay 2009; Frick et al. 2010; Grodski et al. 2012). With the continued western movement of white-nose syndrome (WNS) in the United States (Lorch et al. 2016), additional hibernating bat populations may be negatively affected by this fungus. For migratory species, bat mortalities

have been reported as “high” at wind-energy facilities (Arnett et al. 2008; Cryan and Barclay 2009; Grodski et al. 2012). Understanding the distribution and natural history of bats in specific areas is important before they potentially are impacted by such threats. This knowledge should guide decisions regarding placement of wind farms in the future. Unfortunately for many hibernating and migratory species, basic information

is lacking on their distribution and natural history. For example, the Northern Long-eared Myotis (*Myotis septentrionalis*) recently was listed as threatened under the Endangered Species Act (USFWS 2015); however, almost nothing is known on distances moved between summer habitats to winter hibernacula or vice versa throughout its entire distribution in the United States (Geluso et al. 2015). Moreover, less information is known concerning western bats species in the United States compared to those species in the eastern United States.

The first comprehensive account on the distributions of bats in Nebraska was written by Jones (1964), who described twelve species. Since Jones' (1964) treatise, numerous studies have described geographic localities of bats and reproductive attributes from around the state (e.g., Kunz 1965; Czaplewski 1979; Benedict et al. 2000; Benedict 2004; Geluso et al.

2004a, b; Geluso 2006; Geluso et al. 2008; Serbousek and Geluso 2009; Geluso et al. 2013; Geluso and Geluso 2016; Stein and White 2016; White et al. 2016). Studies also suggest that some species have expanded distributional limits in response to habitat changes in the state (Benedict et al. 2000; Serbousek and Geluso 2009).

To date, limited information is known regarding bats in south-central Nebraska. Herein we report on a number of distributional and reproductive records from the region. Understanding the natural history of bats is important to further conserve these mammals, as the area has not yet been impacted by white-nose syndrome or wind-energy facilities. The region is biogeographically important as it lies at the distributional limits for a number of species in Nebraska (Czaplewski et al. 1979; Benedict 2004), including the federally threatened Northern Long-eared Myotis.

METHODS

From 2006 to 2016, we attempted to capture bats with mist nets on 29 occasions in eight counties (i.e., Buffalo, Dawson, Hall, Hamilton, Harlan, Howard, Kearney, and Webster) in south-central Nebraska. Bats were captured under bridges and in buildings as well as along rivers, streams, ponds, and sloughs (Figs. 1 and 2). All sites were in or adjacent to forested habitats composed primarily of Eastern Cottonwoods (*Populus deltoides*), Eastern Redcedars (*Juniperus virginiana*), and Russian Olives (*Elaeagnus angustifolia*). Survey sites often had agricultural fields or grasslands within a short distance.

Mist nets (Avinet, Inc., Dryden, NY) were set up prior to dusk and monitored for a few hours until bat activity declined. Time of capture, species, sex, age, reproductive condition, forearm length, and body weight were recorded for most bats. Determination of age was based on presence of cartilage in digits at epiphyses of wing bones (Anthony 1988). If cartilage was not observed it was considered an adult, although some bats captured in August and in later months certainly were young-of-the-year with completely ossified wing bones. Bats were released at the site of capture except for a few individuals that were prepared as voucher specimens and deposited into natural history collections

at the University of Nebraska State Museum (UNSM), University of Nebraska at Lincoln, or at the Museum of Southwestern Biology, Albuquerque, New Mexico. Coordinates of localities were determined with handheld global positioning units using NAD 27 or NAD 83. Occasionally, localities were obtained via Google Earth using WGS 84.

Additional bats were either donated to us by others or opportunistically observed roosting on a building (i.e., Dawson and Buffalo counties). We also observed bats on three occasions in the Happy Jack Chalk Mine in Greeley County. We only report the number of Big Brown Bats (*Eptesicus fuscus*) in this study because the American Perimyotis (*Perimyotis subflavus*) was the focus of a prior study (Damm and Geluso 2008).

We also queried the University of Nebraska State Museum and University of Nebraska at Kearney (UNK) for specimens from 16 counties (i.e., Adams, Buffalo, Custer, Dawson, Franklin, Furnas, Gosper, Greeley, Hall, Harlan, Howard, Kearney, Phelps, Sherman, Valley, and Webster) from the region. Previously unpublished records from UNSM and UNK (although collected by other individuals) are included below.



Figure 1. Netting site at the Blue Hole State Wildlife Management Area (3.7 km S, 1.5 km W Elm Creek; 40.68462°N, 99.39291°W), Buffalo County, Nebraska. Photograph was taken 21 May 2017, although bats were captured at this site on 19 June 2013. Pooled water represents a small side channel of the Platte River, which was located about 50 m to the south of the netting site. We captured Evening Bats (*Nycticeius humeralis*) and one Hoary Bat (*Lasiurus cinereus*) at this site. Photograph by Keith Geluso.



Figure 2. Netting site along Prairie Dog Creek (9 km S Alma, 40.01548°N, 99.36324°W), Harlan County, Nebraska. Photograph was taken 21 May 2017, although two Northern Long-eared Myotis (*Myotis septentrionalis*) were captured at this same site on 5 September 2014. Other species captured at the site included the Evening Bat (*Nycticeius humeralis*) and Big Brown Bat (*Eptesicus fuscus*). Photograph by Keith Geluso.

We follow Bradley et al. (2014) for the order of species as well as the common and scientific names in the accounts of species, below. Both geographic and reproductive records for each species are presented in alphabetical order by county within each account. For distributional maps, we plotted our new records as solid symbols, and previously published localities of occurrences were plotted as open symbols from the following publications: Jones 1964; Czaplewski et al. 1979; Benedict et al. 2000; Benedict 2004; Geluso et al. 2004a, b; Geluso 2006; Geluso et al. 2008; Serbousek

and Geluso 2009; Geluso et al. 2013; Geluso and Geluso 2016; Stein and White 2016; and White et al. 2016. We did not include localities on distribution maps where only acoustic data were reported (i.e., White et al. 2016). Following Benedict (2004), reproductive records include data from pregnant females, lactating females, and volant young with cartilage in digits of wing bones. Museum numbers from the Division of Zoology at UNSM are given for those retained as voucher specimens. Some details of habitat for our capture sites are provided in accounts.

RESULTS AND DISCUSSION

From August 2006 to October 2016, we conducted 29 nights of netting and captured 113 bats in south-central Nebraska. We documented another seven individuals from opportunistic observations or donations from others. Data received from UNSM accounted for an additional 27 specimens, 15 of which represented distributional or reproductive records. Only individuals representing new geographic, reproductive, or seasonal records are described below in the accounts of species. We report on 22 county records of seven species from a total of 12 counties, including the expansion of known distributional limits for the Northern Long-eared Bat, Evening Bat (*Nycticeius humeralis*), and American Perimyotis in the state. Fifteen reproductive records also were documented from four species in nine counties, including the earliest volant young for the Eastern Red Bat (*Lasiurus borealis*) and the latest date of pregnancy for the Evening Bat in the state.

ORDER CHIROPTERA

Family Vespertilionidae

Eptesicus fuscus (Palisot de Beauvois, 1796)

Big Brown Bat

The Big Brown Bat occurs statewide across Nebraska, but distributional records are absent from many counties (Jones 1964; Benedict 2004). Female Big Brown Bats likely bear and raise young in every county, as the species commonly inhabits human-made structures (Czaplewski et al. 1979). However, evidence of reproduction for Big Brown Bats is lacking from most counties in Nebraska (Benedict 2004). Most prior reproductive records are reported from eastern (Geluso et al. 2004; Benedict 2004), northern (Czaplewski et al.

1979; Benedict 2004), western (Czaplewski et al. 1979; Geluso et al. 2013; Benedict 2004), and southwestern (Serbousek and Geluso 2009) counties, but none previously was reported from south-central Nebraska (Benedict 2004). Six new distributional county records and three new reproductive records are described below.

Geographic records.—New geographic distributional records are presented for six counties (i.e., Dawson, Franklin, Greeley, Hall, Howard, and Kearney) in south-central Nebraska (Fig. 3). Such records fill in gaps in the known distribution of *E. fuscus*, although the species is known from a number of nearby counties (Benedict 2004). In Dawson County, two males were collected from the city of Gothenburg, one in 1988 and one on 5 March 2001 (UNSM ZM# 30398 and ZM# 30417, respectively). In Franklin County, one adult male was collected on 6 July 2004 along Turkey Creek (1.6 km N, 0.2 km E Naponee; UNSM ZM# 29233). In Greeley County, Big Brown Bats previously were not documented in the Happy Jack Chalk Mine in 2002 (Benedict 2004) nor in 2005 or 2006 (Damm and Geluso 2008). On 8 March 2009, 18 October 2012 (UNSM ZM# 30977), and 25 April 2013, single individuals were observed hibernating in the mine (2.8 km S, 0.4 km W Scotia; 41.4415°N, 98.7080°W, WGS 84). Openings at the two entrances of the mine formerly were solid wood except for a narrow crack along the top of both doors where bats could access passageways in 2005 and 2006. From at least 2009 to 2016, wooden doors were replaced with open metal gates, yielding cooler temperatures and increased air currents between openings. The area between the openings corresponds to the location where all Big Brown

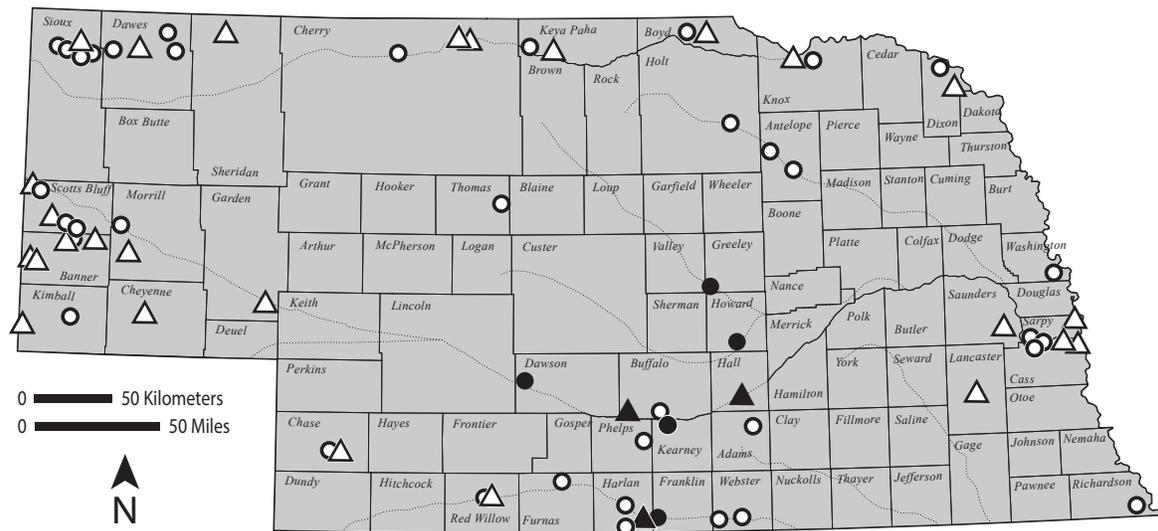


Figure 3. New distributional and reproductive records of the Big Brown Bat (*Eptesicus fuscus*) in Nebraska. Open symbols represent previously published records, and closed symbols represent new records presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). Some closed triangles also indicate new geographical county records. Shaded area represents the known distribution of the species in Nebraska.

Bats have been observed thus far in the mine. In Hall County, 12 pregnant females were captured at the Crane Trust either in a building ($n = 7$; near Headquarters; 40.7885°N, 98.4646°W, WGS 84) or along a perennial slough along the Platte River ($n = 5$; 2.2 km N, 8.1 km W Doniphan; 40.79129°N, 98.46539°W, NAD 83), two on 3 June 2011, nine on 13 June 2013, and one on 14 June 2013 (UNSM ZM# 30981, from the slough). In Howard County, one individual was captured on 17 August 2006 along Oak Creek near Dannebrog under a roadway bridge on Nebraska Highway 11 (Oak Creek; 41.1130°N, 98.5523°W, NAD 83; individual released). In Kearney County, an adult male was captured on 15 July 2013 over a small pond within 100 m of the main channel of the Platte River (19.7 km N, 3.7 km E Axtell; 40.65655°N, 99.08383°W, NAD 83; UNSM ZM# 30989). The area contained numerous Eastern Cottonwoods and Eastern Redcedars.

Reproductive records.—Three new reproductive records are presented from Buffalo, Hall, and Harlan counties (Fig. 3). In Buffalo County, a lactating female was captured on 19 June 2013 from the Blue Hole State Wildlife Management Area over a small pond

surrounded by primarily Eastern Cottonwoods (3.8 km S, 1.0 km W Elm Creek; 40.68408°N, 99.38763°W, NAD 83; UNSM ZM# 30984). In Hall County, 12 pregnant females were captured from two localities at the Crane Trust in the flood plain of the Platte River on 3 June 2011, 13 June 2013, and 14 June 2013. Five individuals were captured along a small perennial slough surrounded by deciduous trees near the Platte River, and seven were captured from a large building that regularly contained small groups of night-roosting individuals (details of localities are given above). The one pregnant female kept as a voucher specimen on 13 June contained two fetuses with crown-rump lengths of 25 and 23 mm (UNSM ZM# 30981). In Harlan County, a volant young male was captured 7 July 2004 (3.5 km S, 1.3 km E Republican City; UNSM ZM# 29239).

All reproductive records are within the known dates of reproduction in the state for Big Brown Bats, including pregnant females (4 May–14 July; Geluso et al. 2004a and Czaplowski et al. 1979, respectively), lactating females (31 May–5 September; Geluso et al. 2004a and Jones 1964, respectively), and volant young (6 July–21 September; Geluso et al. 2004a). Our ob-

servation of *E. fuscus* with two pups in south-central Nebraska best matches more eastern populations (*E. f. fuscus*) in the state, as the northern part of our study area is within a broad zone of intergradation between the two subspecies and the southern part of our study area appears dominated by the eastern subspecies (Hoffman and Genoways 2008).

Lasionycteris noctivagans (Le Conte, 1831)

Silver-haired Bat

Silver-haired Bats once were considered only a migratory species in Nebraska, occurring seasonally in both spring and autumn (Czaplewski et al. 1979). More recently, however, reproduction by females in summer has been shown in several localities in extreme eastern and western parts of the state (Benedict 2004; Geluso et al. 2004a,b; Geluso et al. 2013). Throughout central parts of Nebraska, relatively few records of this species exist in the literature (Benedict 2004; Geluso 2006). Herein we report on two new county records from Buffalo and Sherman counties (Fig. 4).

Geographic records.—In Buffalo County, we captured an adult male with subcutaneous fat deposits roosting on the outside of a brick building at

the University of Nebraska at Kearney (UNK) on 24 October 2016 (Bruner Hall of Science; 40.6999°N, 99.09513°W, NAD 83; UNSM ZM# 31036). On 23 September 1992, another individual was collected by others from the city of Kearney (17 Camelot Way, UNK# 4055). In Sherman County, a female was collected by others on 23 September 1994 from 8.0 km N, 3.2 km E Litchfield (UNSM ZM# 26056). These late seasonal captures suggest individuals were migrating. Wind-energy facilities are known in central parts of Nebraska by Ainsworth in Brown County and Broken Bow in Custer County, as well as to the south in central Kansas. Further information is warranted to better understand the numbers and timing of migration by *L. noctivagans* using the central flyway, as future wind-energy facilities are planned in the Great Plains. Another explanation for such occurrences is that they represent individuals preparing to hibernate in the region. To date, there is no conclusive observation of a Silver-haired Bat hibernating in the state, but there have been two late captures indicating that individuals might overwinter in Nebraska (Benedict 2004; Geluso et al. 2004b; Geluso et al. 2013). Silver-haired Bats are known to hibernate at latitudes of Nebraska and farther north (Jones et al. 1983).

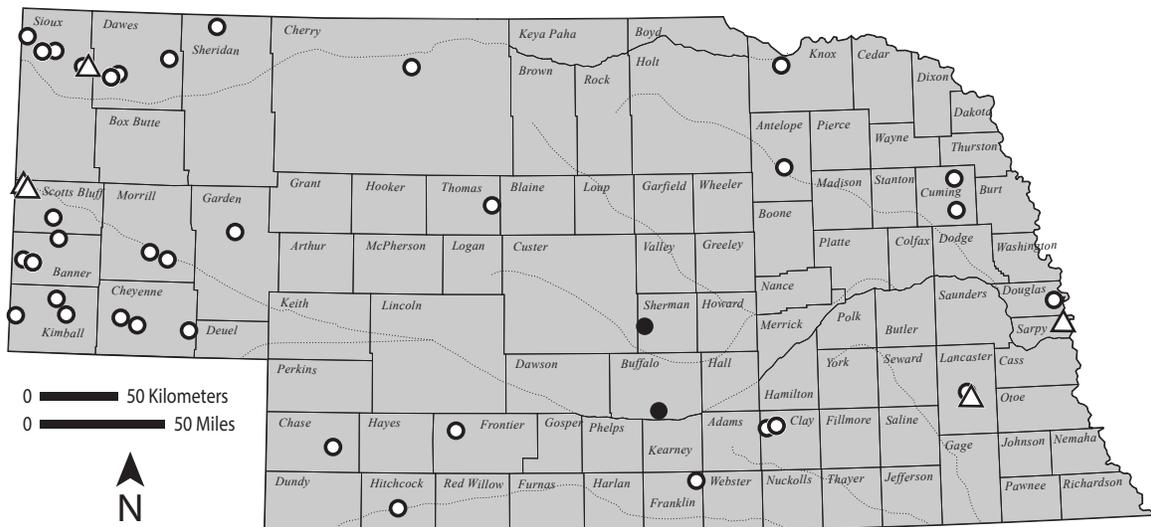


Figure 4. New distributional records of the Silver-haired Bat (*Lasionycteris noctivagans*) in Nebraska. Open symbols represent previously published records, and closed symbols represent new records presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). Shaded area represents the known distribution of the species in Nebraska.

The female from Sherman County, described above, originally was reported as a juvenile on the specimen tag; however, one of us (KG) further examined this museum specimen. Based on the shape of the wing bones at the joints, the individual is best referred to as an adult, albeit it might represent a young with ossified epiphyses.

Lasiurus borealis (Müller, 1776)
Eastern Red Bat

The Eastern Red Bat occurs statewide but is more common in eastern Nebraska (Czaplewski et al. 1979). Recent studies suggest that *L. borealis* has increased in abundance in western parts of the state, although these individuals mainly are migratory (Geluso et al. 2013; Geluso et al. 2015; Geluso and Geluso 2016). Numerous counties in the state lack records of this migratory, tree-roosting species (Benedict 2004). Females are reported to give birth and raise young across the state (Benedict 2004); however, recent surveys failed to document reproductive females in extreme western Nebraska (Geluso et al. 2013; Geluso and

Geluso 2016). Older records demonstrate that some females occasionally bear young in western Nebraska, as a female and four young were reported from Morrill County (Benedict et al. 2000) and a lactating female is known from Sioux County (Czaplewski et al. 1979). Reproductive evidence is lacking in many counties, and most reproductive records are from the northern, eastern, and south-central parts of the state (Benedict 2004). Herein we report on five new geographic county records and six new reproductive records.

Geographic records.—New geographic distributional records are presented for five counties (i.e., Dawson, Franklin, Kearney, Hall, and Webster) in south-central Nebraska (Fig. 5). Such records fill in gaps in the known distribution of *L. borealis*, although a number of nearby counties have records of occurrence (Czaplewski et al. 1979; Benedict 2004). In Dawson County, three Eastern Red Bats were reported from the city of Gothenburg, one adult female in 1988 (unspecified date; UNSM ZM# 30397), one juvenile female on 14 July 2013 (UNSM ZM# 30995), and one juvenile male (unspecified date; UNSM ZM# 30996).

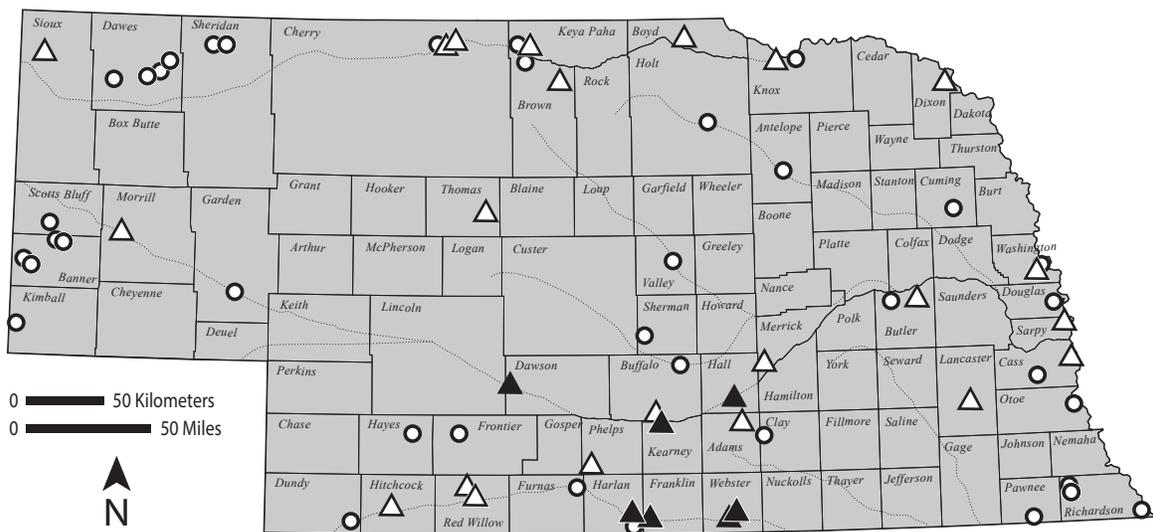


Fig. 5. New distributional and reproductive records of the Eastern Red Bat (*Lasiurus borealis*) in Nebraska. Open symbols represent previously published records, and closed symbols represent new records presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). Some closed triangles also indicate new geographical county records. Benedict (2004) reported a record in Kearney County. We were unable to locate the publication or specimen of this record, thus we consider our capture to represent the first observation for the county. Shaded area represents the known distribution of the species in Nebraska.

In Franklin County, a lactating female was reported on 6 July 2004 along Turkey Creek (1.6 km N, 0.2 km E Naponee; UNSM ZM# 29234). In Hall County, we captured one lactating female on 11 July 2009 (2.3 km N, 7.8 km W Doniphan, 40.7922°N, 98.4623°W, NAD 83; UNSM ZM# 30979) along a perennial slough surrounded by many deciduous trees dominated by Eastern Cottonwoods in the flood plain of the Platte River. In Kearney County, a volant young female was captured on 17 July 2013 over a small pond near the Platte River surrounded by a mature forest of Eastern Cottonwoods and Eastern Redcedars (19.7 km N, 3.7 km E Axtell; 40.65655°N, 99.08383°W, NAD 83; UNSM ZM# 30997). In Webster County, one lactating female was captured and released on 26 June 2007 over the Republican River (Indian Creek State Wildlife Management Area, 40.0616°N, 98.5198°W, NAD 83) and five volant young females and one volant young male (UNSM ZM# 31035; 4 July) were captured on 4 and 5 July 2015 along Elm Creek (Elm Creek State Wildlife Management Area, 3.3 km N, 6.3 km E Red Cloud; 40.11818°N, 98.44521°W, NAD 83). Both areas in Webster County contained deciduous forests along waterways.

Reproductive records.—New reproductive records are presented for Dawson, Franklin, Hall, Harlan, Kearney, and Webster counties (Fig. 5). In Dawson County, two juveniles were collected from the city of Gothenburg (see details above). It is unknown whether individuals were volant, but we suspect at least one, if not both, could not fly based on small forearm lengths (38 and 36 mm; UNSM ZM# 30995, 30996; respectively). In Franklin County, a lactating female was captured along Turkey Creek in 2004 (see details above). In Hall County, a lactating female was captured in 2009 (see details above). In Harlan County, two volant young males were captured on 7 July 2004 (3.5 km S, 1.3 km E Republican City, and 2.9 km S, 3.2 km W Republican City; UNSM ZM# 29240 and 29242, respectively). In Kearney County, a volant young female was captured near the Platte River in 2013 (see details above). In Webster County, a lactating female and six volant young were captured in 2007 and 2015 (see details above).

Dates of lactation reported herein fall within the known dates previously reported in the state for Eastern Red Bats (30 May–27 July; Benedict 2004).

The three volant young *L. borealis* captured on 4 July represent the earliest known capture of a volant young in Nebraska. The previous earliest record for a volant young in the state was 13 July (Benedict 2004).

***Lasiurus cinereus* (Palisot de Beauvois, 1796)**

Hoary Bat

The Hoary Bat is a migratory, tree-roosting species that occurs across Nebraska (Czaplewski et al. 1979; Benedict 2004). Geographic and reproductive records have not been documented from many counties in the state (Czaplewski et al. 1979; Benedict 2004). Reproductive data are on record mainly from edges of the state (Benedict 2004; Geluso et al. 2004a; Serbousek and Geluso 2009; Geluso et al. 2013), with only a few reproductive records from interior portions of the state (Benedict 2004; Geluso 2006). We present a single geographic and reproductive record for an interior county in the state (Fig. 6).

Geographic record.—In Hamilton County, a volant young male was captured on 9 July 2008 under the canopy of large Eastern Cottonwood trees adjacent to the Platte River (5.6 km W, 1.6 km N Marquette; 41.01798°N, 98.07577°W, NAD 83; UNSM ZM# 29922).

Reproductive record.—The aforementioned volant young also represents a new reproductive record for Hamilton County. This date falls within the known dates of volant young in Nebraska (late June–14 August; Czaplewski et al. 1979 and Geluso et al. 2013, respectively).

***Myotis septentrionalis* (Trouessart, 1897)**

Northern Long-eared Myotis

The Northern Long-eared Myotis has a distribution that encompasses parts of extreme northern, eastern, and southern Nebraska (Benedict 2004; Geluso et al. 2015; White et al. 2016). Understanding the distribution of this species is important, as the species recently was listed as threatened under the Endangered Species Act due to large-scale mortalities associated with WNS in the eastern United States (USFWS 2015). Two county records are presented herein that expand its known distribution in southern Nebraska (Fig. 7).

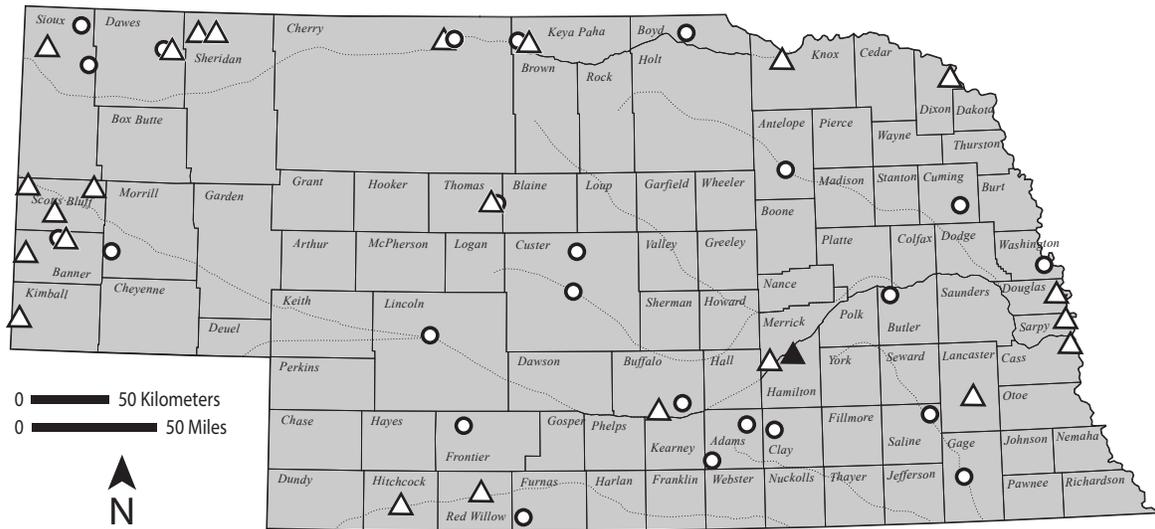


Figure 6. A new distributional and reproductive record of the Hoary Bat (*Lasiurus cinereus*) in Nebraska. Open symbols represent previously published records, and the closed symbol represents new records presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). The closed triangle also indicates a new geographical county record. Shaded area represents the known distribution of the species in Nebraska.

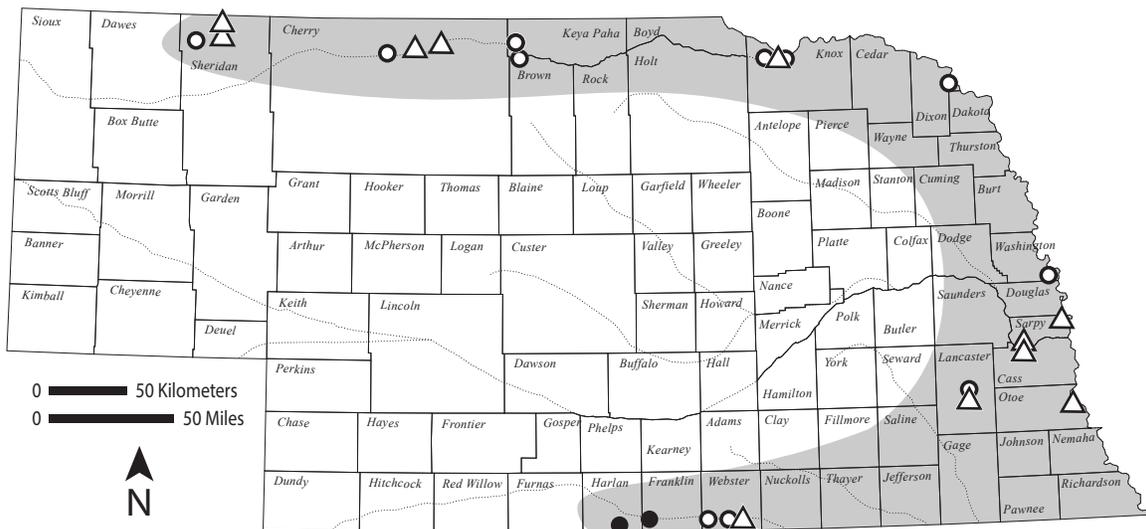


Figure 7. New distributional records of the Northern Long-eared Myotis (*Myotis septentrionalis*) in Nebraska. Open symbols represent previously published records, excluding acoustic data, and closed symbols represent new records presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). White et al. (2016) reported published or museum records from Gage and Johnson counties; however, there are no published records or specimens from those counties (C. A. Lemen, in litt.). Shaded area represents the known distribution of the species in Nebraska.

Geographic records.—New geographic records are presented from two counties (i.e., Franklin and Harlan), with capture sites along small tributaries of the Republican River in southern Nebraska. In Franklin county, a male with testes measuring 3.5 mm in length was collected on 6 July 2004 along Turkey Creek (1.6 km N, 0.2 km E Naponee, 40.08927°N, 99.13918°W; UNSM ZM# 28915). In Harlan County, we captured three individuals. Two females were captured along Prairie Dog Creek on 5 September 2014 (9 km S Alma, 40.01548°N, 99.36324°W, NAD 83; UNSM ZM# 30990, 30991). One individual was an adult (UNSM ZM# 30990) based on brown coloration of fur, heavier weight (9.5 g), and presence of subcutaneous fat stores whereas the other female (UNSM ZM# 30991) likely was a young with ossified wing bones based on its gray fur coloration, light weight (6 g), and lack of subcutaneous fat. Additionally, an adult male was captured on 9 September 2016 under a cement I-beam bridge spanning Prairie Dog Creek along US Hwy 183 (9.4 km S, 0.5 km W Alma; 40.01336°N, 99.36723°W, WGS 84, individual released). The individual was captured in a mist net at night near the northern abutment.

Captures of Northern Long-eared Myotis in these counties likely represent a recent westward expansion of the species along the Republican River, as the site in Harlan County has been netted every other year since 2006 but only documented in 2014 and 2016 (Geluso et al. 2008). Acoustic data further support the occurrence of *M. septentrionalis* in Harlan County in summer (White et al. 2016). Continued surveys should monitor this species, as it might continue to expand westward along the Republican River, especially because bedrock reaches the ground surface farther west along the river potentially providing suitable hibernacula (Lemen et al. 2016). The Northern Long-eared Myotis also has expanded its distribution in the Pine Ridge and along the Niobrara River in northern Nebraska in recent times (Benedict et al. 2000; Geluso et al. 2015) as well as in Kansas since the 1960s (Sparks et al. 2011). Research is warranted to attempt to learn as much about this species in the state regarding where it occurs and reproduces, as well as routes and distances traveled between winter and summer roosts. It is possible that the species occurs in other wooded regions of the state. In Arkansas and Louisiana, for example, populations have been discovered beyond former historical records in the region (Crnkovic 2003; Sasse et al. 2014).

***Nycticeius humeralis* (Rafinesque, 1818)**
Evening Bat

The Evening Bat originally was documented only in southeastern Nebraska (Jones 1964; Czaplewski et al. 1979). Recent records from northeastern and southwestern Nebraska demonstrate that the species has expanded its distribution in the state (Benedict 2004; Serbousek and Geluso 2009). With recent range expansions across the Great Plains in Kansas (Phelps et al. 2008; Sparks et al. 2011), Nebraska (Benedict 2004; Serbousek and Geluso 2009), South Dakota (Lane et al. 2003), and Texas (Ammerman et al. 2012), distribution of this species needs to be monitored as it likely will continue to expand its distribution. Five county records and five reproductive records are presented below.

Geographic records.—New geographic records are presented from Buffalo, Franklin, Furnas, Hall, and Kearney counties (Fig. 8). In Buffalo County, Evening Bats were captured at two sites in the flood plain of the Platte River, at the Crane Trust and Blue Hole State Wildlife Management Area. One pregnant female was captured on 7 June 2013 (UNSM ZM# 30978) and a lactating female and volant young male were captured on 15 July 2013 (Crane Trust, Dipple Property, 4.3 km S, 4.5 km E Gibbon; 40.70806°N, 98.79181°W, NAD 83; UNSM ZM# 30985, 30986). At the Blue Hole State Wildlife Management Area, six lactating females were captured on 19 June 2013 (five individuals at 3.7 km S, 1.5 km W Elm Creek; 40.68462°N, 99.39291°W, NAD 83; UNSM ZM# 30983; and one individual at 3.8 km S, 1.0 km W Elm Creek; 40.68408°N, 99.38763°W, NAD 83). Habitat at capture sites in Buffalo County consisted of open pools of water on side channels or sloughs of the Platte River bordered by deciduous forests. In Franklin County, two lactating females were captured on 6 July 2004 along Turkey Creek (1.6 km N, 0.2 km E of Naponee; UNSM ZM# 28914, 29232). In Furnas County, one lactating female was captured on 8 July 2004 along Medicine Creek (1.0 km E Cambridge; UNSM ZM# 28923). In Hall County, one pregnant female was captured on 13 July 2013 along a perennial slough bordered by deciduous trees (Crane Trust, 2.2 km N, 8.1 km W Doniphan; 40.79129°N, 98.46539°W, NAD 83; UNSM ZM# 30980). In Kearney County, four individuals were captured over a small pond near the Platte River surrounded by a forest dominated by Eastern Redcedars and Eastern Cottonwoods. Two

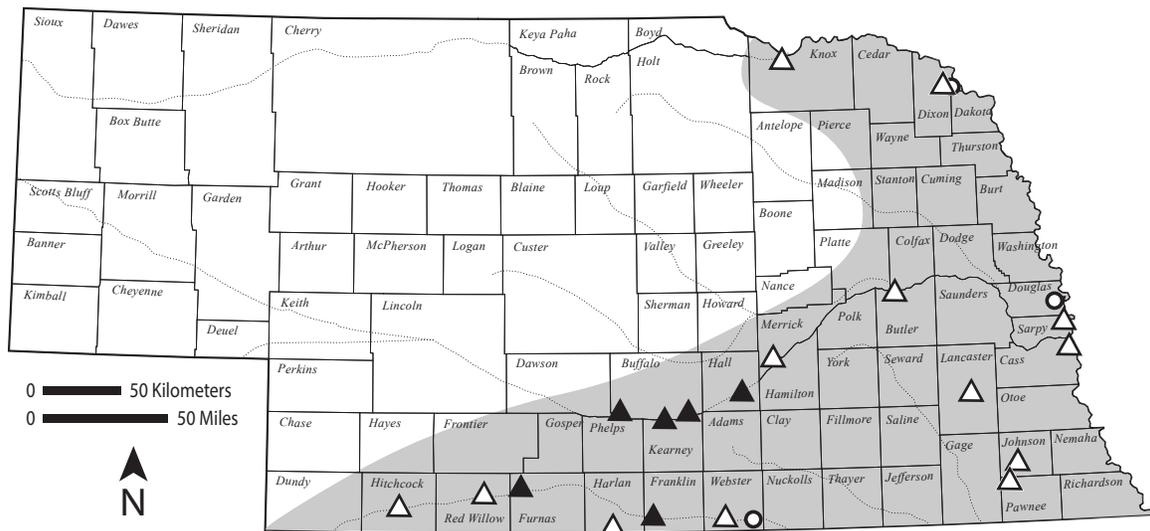


Figure 8. New distributional and reproductive records of the Evening Bat (*Nycticeius humeralis*) in Nebraska. Open symbols represent previously published records, and closed symbols represent new records presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). All closed triangles also indicate new geographical county records. Shaded area represents the known distribution of the species in Nebraska.

adult females were captured on 15 July 2013 (UNSM ZM# 30988, 30999) and one volant young of unknown sex and one volant male (UNSM ZM# 30998) were captured on 17 July 2013 (19.7 km N, 3.7 km E Axtell, 40.65655°N, 99.08383°W, NAD 83).

Evening Bats along the Platte River in Buffalo and Hall counties potentially represent a westward and northward expansion of the species in south-central Nebraska. We failed to capture the species along the Platte River in 2006 in Buffalo County and specimens of other species were previously known from along the Platte River (Czaplewski et al. 1979), lending some support that the species was not present in the area in the past. The closest records of *N. humeralis* from the Blue Hole State Wildlife Management Area in Buffalo County are from 109 km to the east at Bader Park, Merrick County, along the Platte River (Benedict et al. 2000) and from 75 km to the south at Prairie Dog Creek, Harlan County, along the Republican River (Geluso et al. 2008). It is unclear whether the source for this range expansion is from populations farther east along the Platte River or to the south from the Republican River. In the future, we suspect this species will expand into

additional wooded habitats farther west along the Platte River and into other river systems to the north, such as the Loup rivers and Dismal River in more central parts of the state.

Reproductive records.—Reproductive records are reported from five counties (i.e., Buffalo, Franklin, Furnas, Hall, and Kearney; Fig. 8), the same counties as geographic records, hence additional details of localities of occurrences and habitats are listed above. Reproductive records from Buffalo County include a pregnant female with two fetuses (largest crown-rump length was 15 mm) captured on 7 June 2013 (UNSM ZM# 30978), six lactating females captured on 19 June 2013 (UNSM ZM# 30983), and one lactating female and one volant young male captured on 15 July 2013 (UNSM ZM# 30985, 30986; respectively). In Franklin County, two lactating females were captured on 6 July 2004 (UNSM ZM# 28914, 29232). In Furnas County, one lactating female was captured on 8 July 2004 (UNSM ZM# 28923). In Hall County, one pregnant female with three fetuses (20, 18, and 18 mm crown-rump lengths) was captured on 13 June 2013 (UNSM ZM# 30980). In Kearney County, two post-lactating

females were captured on 15 July 2013 (UNSM ZM# 30988, 30999) and two volant young were captured on 17 July 2013 (UNSM ZM# 30998).

Previous dates of pregnant Evening Bats in the state ranged from 10 May–1 June (Geluso et al. 2004a and Czaplewski et al. 1979, respectively). The pregnant female captured in Hall County on 13 June represents the latest date of pregnancy for *N. humeralis* in the state. Dates of lactation reported herein fall within the known dates previously reported for Evening Bats (15 June–24 July; Serbousek and Geluso 2009 and Kunz 1965, respectively). Volant young with cartilage are known from 23 June–7 September in Nebraska (Serbousek and Geluso 2009 and Benedict 2004, respectively), and our dates of capture for volant young fall within this range.

Perimyotis subflavus (F. Cuvier 1832)

American Perimyotis

The American Perimyotis, formerly called the Eastern Pipistrelle or Tricolored Bat (*Pipistrellus sub-*

flavus), was known originally from extreme eastern parts of the state in Cass and Sarpy counties (Jones 1964; Czaplewski et al. 1979). Benedict (2004) documented a few scattered records in central and northern Nebraska, with reproductive individuals recorded along the northern border of the state. A recent acoustical study suggested that *P. subflavus* also occurs in other scattered localities in eastern Nebraska and along the Republican River in forested areas (White et al. 2016). Geluso et al. (2005) proposed the distribution for this species spans across Nebraska and the central Great Plains states, as individuals now have been observed in southwestern South Dakota, eastern Wyoming, north-central Colorado, and eastern New Mexico. Herein, we report on a single geographic record in the state (Fig. 9).

Geographic records.—In Buffalo County, solitary females were collected on 23 August 2002 and 1 September 2002 from buildings in the city of Kearney (UNSM ZM# 28248 and 28249, respectively), indicating the species also occasionally uses above-ground human-made structures in the state. These records ex-

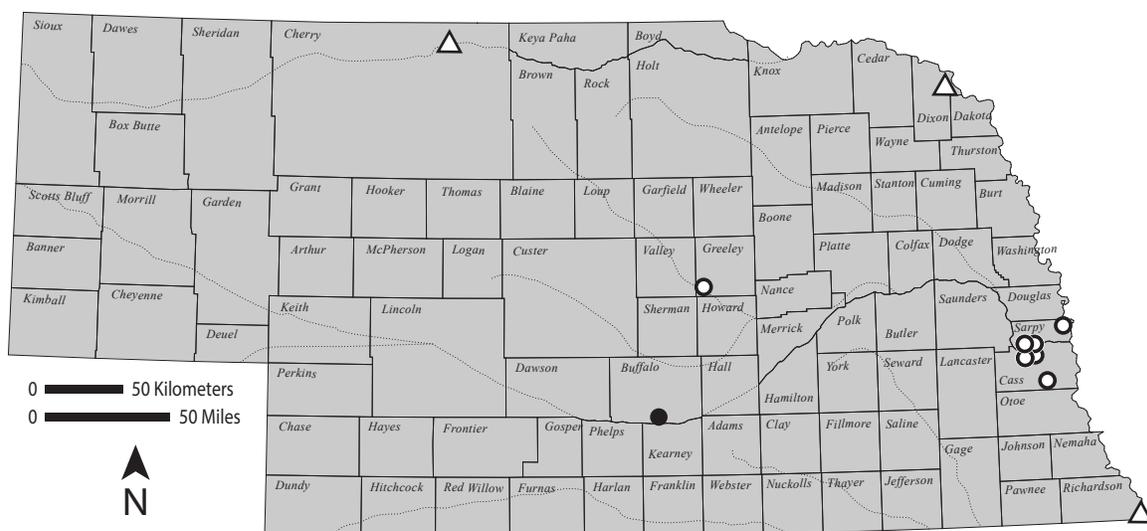


Figure 9. A new distributional record of the American Perimyotis (*Perimyotis subflavus*) in Nebraska. Open symbols represent previously published records, excluding acoustic data, and the closed symbol represents a new record presented in this paper. Circles represent geographic records, and triangles represent reproductive records (i.e., pregnant females, lactating females, and volant young with cartilaginous epiphyseal plates in wing bones). The entire state is shaded indicating that the species occurs throughout Nebraska, although records are absent from western parts of the state. However, distributional records for this species are known from eastern Wyoming, northeastern Colorado, and southwestern South Dakota (Geluso et al. 2005). White et al. (2016) reported a published or museum record from Lancaster County; however, there is no published record or voucher specimen from that county (C. A. Lemen, in litt.). Shaded area represents the known distribution of the species in Nebraska.

tend the known distribution in the state westward along the Platte River. These two specimens recently were mentioned in White et al. (2016) but without specific locality data. Researchers have reported that *P. subflavus* is difficult to capture in eastern Nebraska via the traditional deployment of mist nets, whereas acoustic

recording devices demonstrate that the species might be abundant in areas with no or few captures (White et al. 2016). Thus, the American *Perimyotis* likely occurs in other areas of the state farther west along wooded streams and rivers containing nearby rocky outcrops or human-made structures suitable for hibernation.

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LITERATURE CITED

- Ammerman, L. K., C. L. Hice, and D. J. Schmidly. 2012. Bats of Texas. Texas A&M University Press. College Station, Texas.
- Anthony, E. L. P. 1988. Age determination in bats. Pages 47–58 in *Ecological and behavioral methods for the study of bats* (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, DC.
- Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, and R. D. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. *Journal of Wildlife Management* 72:61–78.
- Benedict, R. A. 2004. Reproductive activity and distribution of bats in Nebraska. *Western North American Naturalist* 64:231–248.
- Benedict, R. A., H. H. Genoways, and P. W. Freeman. 2000. Shifting distributional patterns of mammals in Nebraska. *Transactions of the Nebraska Academy of Sciences* 26:55–84.
- Bradley, R. D., L. K. Ammerman, R. J. Baker, L. C. Bradley, J. A. Cook, R. C. Dowler, C. Jones, D. J. Schmidly, F. B. Stangl, Jr., R. A. Van Den Bussche, and B. Würsig. 2014. Revised checklist of North American mammals north of Mexico, 2014. *Occasional Papers, Museum of Texas Tech University* 327:1–27.
- Cryan, P. M., and M. R. Barclay. 2009. Causes of bat fatalities at wind turbines: Hypotheses and predictions. *Journal of Mammalogy* 90:1330–1340.
- Crnkovic, A. C. 2003. Discovery of Northern Long-eared *Myotis*, *Myotis septentrionalis* (Chiroptera: Vespertilionidae), in Louisiana. *The Southwestern Naturalist* 48:715–717.
- Czaplewski, N. J., J. P. Farney, J. K. Jones, Jr., and J. D. Druecker. 1979. Synopsis of bats of Nebraska. *Occasional Papers, Museum of Texas Tech University* 61:1–24.
- Damm, J. P., and K. Geluso. 2008. Use of a mine by Eastern Pipistrelles (*Perimyotis subflavus*) in east central Nebraska. *Western North American Naturalist* 68:382–389.

- Frick, W. F., J. F. Pollock, A. C. Hicks, K. E. Langwig, D. S. Reynolds, G. G. Turner, C. M. Butchkoski, and T. H. Kunz. 2010. An emerging disease causes regional population collapse of a common North American bat species. *Science* 329:679–682.
- Geluso, K. 2006. Bats in a human-made forest of central Nebraska. *The Prairie Naturalist* 38:13–23.
- Geluso, K. N., and K. Geluso. 2016. Bats of Kimball and Cheyenne counties, Nebraska. Pp. 183–200 in *Contributions in natural history: A memorial volume in honor of Clyde Jones* (R. W. Manning, J. R. Goetze, and F. D. Yancey, II, eds.). Special Publications, Number 65, Museum of Texas Tech University, Lubbock, Texas.
- Geluso, K. N., R. A. Benedict, and F. L. Kock. 2004a. Seasonal activity and reproduction in bats of east-central Nebraska. *Transactions of the Nebraska Academy of Sciences* 29:33–44.
- Geluso, K., J. P. Damm, and E. W. Valdez. 2008. Late-seasonal activity and diet of the Evening Bat (*Nycticeius humeralis*) in Nebraska. *Western North American Naturalist* 68:21–24.
- Geluso, K., J. J. Huebschman, J. A. White, and M. A. Bogan. 2004b. Reproduction and seasonal activity of Silver-haired Bats (*Lasionycteris noctivagans*) in western Nebraska. *Western North American Naturalist* 64:353–358.
- Geluso, K., J. J. Huebschman, and K. N. Geluso. 2013. Bats of the Wildcat Hills and surrounding areas in western Nebraska. *Monographs of the Western North American Naturalist* 6:20–42.
- Geluso, K., C. A. Lemen, and P. W. Freeman. 2015. Current status of the Northern Long-eared Myotis (*Myotis septentrionalis*) in northwestern Nebraska. *Transactions of the Nebraska Academy of Sciences* 35:34–40.
- Geluso, K., T. R. Mollhagen, J. M. Tigner, and M. A. Bogan. 2005. Westward expansion of the Eastern Pipistrelle (*Pipistrellus subflavus*) in the United States, including new records from New Mexico, South Dakota, and Texas. *Western North American Naturalist* 65:405–409.
- Grodsky, S. M., C. S. Jennelle, D. Drake, and T. Virzi. 2012. Bat mortality at a wind-energy facility in southeastern Wisconsin. *Wildlife Society Bulletin* 36:773–783.
- Hoffman, J. D., and H. H. Genoways. 2008. Characterization of a contact zone between two subspecies of the Big Brown Bat (*Eptesicus fuscus*) in Nebraska. *Western North American Naturalist* 68:36–45.
- Jones, J. K., Jr. 1964. Distribution and taxonomy of mammals of Nebraska. *Publications of the Museum of Natural History, University of Kansas* 16:1–356.
- Jones, J. K., Jr., D. M. Armstrong, R. S. Hoffmann, and C. Jones. 1983. *Mammals of the Northern Great Plains*. University of Nebraska Press, Lincoln.
- Kunz, T. H. 1965. Notes on some Nebraskan bats. *Transactions of the Kansas Academy of Science* 68:201–203.
- Lane, J. E., C. L. Buck, and R. M. Brigham. 2003. The bat fauna of southeastern South Dakota. *The Prairie Naturalist* 35:247–256.
- Lemen, C. A., P. W. Freeman, and J. A. White. 2016. Acoustic evidence of bats using rock crevices in winter: A call for more research on winter roosts in North America. *Transactions of the Nebraska Academy of Sciences* 36:9–13.
- Lorch, J. M., J. M. Palmer, D. L. Lindner, A. E. Ballmann, K. G. George, K. Griffin, S. Knowles, J. R. Huckabee, K. H. Haman, C. D. Anderson, P. A. Becker, J. B. Buchanan, J. T. Foster, and D. S. Blehert. 2016. First detection of bat white-nose syndrome in western North America. *mSphere* 1:e00148-16.
- Phelps, K. L., C. J. Schmidt, and J. R. Choate. 2008. Presence of the Evening Bat (*Nycticeius humeralis*) in westernmost Kansas. *Transactions of the Kansas Academy of Science* 111:159–160.
- Sasse, D. B., M. L. Caviness, M. J. Harvey, J. L. Jackson, P. N. Jordan, T. L. Klotz, P. R. Moore, R. W. Perry, R. K. Redman, T. S. Risch, D. A. Saugey, and J. D. Wilhide. 2014. New records and notes on the ecology of the Northern Long-eared Bat (*Myotis septentrionalis*) in Arkansas. *Journal of the Arkansas Academy of Science* 68:170–173.
- Serbousek, M. R., and K. Geluso. 2009. Bats along the Republican River and its tributaries in southwestern Nebraska: Distribution, abundance, and reproduction. *Western North American Naturalist* 69:180–185.
- Sparks, D. W., C. J. Schmidt, and J. R. Choate. 2011. Bats of Kansas. *Indiana State University Center for North American Bat Research and Conservation* 5:1–60.
- Stein, R. M., and J. A. White. 2016. Maternity colony of Northern Long-eared Myotis (*Myotis septentrionalis*) in a human-made structure in Nebraska. *Transactions of the Nebraska Academy of Sciences* 36:1–5.
- USFWS (US Fish and Wildlife Service). 2015. *Endangered and threatened wildlife and plants; threatened spe-*

cies status for the Northern Long-eared Bat with 4(d) rule. Federal Register 80:17974–18033.

White, J. A., C. A. Lemen, and P. W. Freeman. 2016. Acoustic detection reveals fine-scale distributions of *Myotis*

lucifugus, *Myotis septentrionalis*, and *Perimyotis subflavus* in eastern Nebraska. Western North American Naturalist 76:27–35.

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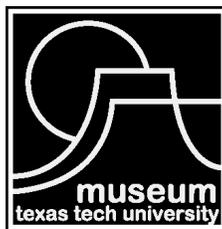
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