Long-legged Myotis

Myotis volans

REGULATORY STATUS

USFWS: No special status
USFS R2: No special status
USFS R4: No special status
Wyoming BLM: No special status
State of Wyoming: Nongame Wildlife

CONSERVATION RANKS

USFWS: No special status
WGFD: NSS4 (Cb), Tier III
WYNDD: G4G5, S5
Wyoming Contribution: LOW
IUCN: Least Concern

STATUS AND RANK COMMENTS

Long-legged Myotis (*Myotis volans*) has a global rank of G4G5 because of uncertainties regarding distribution and threats to the species during winter [1].

NATURAL HISTORY

Taxonomy:

There are four currently recognized subspecies of Long-legged Myotis: *M. v. volans*, *M. v. amotus*, *M. v. interior*, and *M. v. longicrus* [2]. Only *M. v. interior* occurs in Wyoming [3].

Description:

Long-legged Myotis is identifiable in the field. The species is a small vespertilionid bat, medium in size among bats in the genus *Myotis*. Pelage is variable in color with some populations exhibiting local color adaptations [3]. Generally, dorsal pelage ranges from ochraceous buff to dark reddish or blackish brown. Ventral pelage is lighter, ranging from pale buffy to smoky cinnamon brown [3]. The wing and tail membranes and ears are darkly pigmented, nearly black. The ears are rounded and relatively short (12–13 mm), barely reaching the nostrils when folded forward [3, 4]. The tragus is pointed and fairly long (6–8 mm) in relation to the ear [3]. Males and females are identical in appearance, but females have significantly longer forearms than males [3]. Volant juvenile individuals are identical in appearance to adults, but the growth plates in the phalanges of juveniles are visible throughout the first summer [5]. Long-legged Myotis is similar in appearance to other sympatric *Myotis* species. Within the Wyoming range of the species, these include the Little Brown Myotis (*M. lucifugus*), Fringed Myotis (*M. thysanodes*), Long-eared Myotis (*M. evotis*), Western Small-footed Myotis (*M. ciliolabrum*), and Northern Long-eared Myotis (*M. septentrionalis*). Long-legged Myotis can be distinguished from these species by the presence of a distinctly keeled calcar and well-furred underwing between the elbow and the knee [3].

Distribution & Range:
Long-legged Myotis is widely distributed across western North America from extreme northwestern Canada to north-central Mexico. Wyoming falls near the eastern edge of the species distribution. Long-legged Myotis is distributed throughout Wyoming in forested habitats and has been observed in 26 of the state's 28 latitude/longitude degree blocks [6]. In late summer and early fall, the species migrates to hibernacula. However, only one individual has been documented hibernating in Wyoming [7]. Recently, the species has been documented in northern Canada in both the Yukon and Northwest Territories [8-10]. These observations mark extensions to the currently accepted range of the species and likely resulted from a previous lack of extensive bat inventories in these areas rather than range expansions.

Habitat:
Across its range, Long-legged Myotis is primarily associated with forested habitats, especially coniferous forests. The species may also be found in other forest types such as riparian forests, juniper scrub, and mixed deciduous forests [4]. In Wyoming, the species is common in montane forests and may be found at high elevations up to, or even above, tree-line [4]. However, recent bat inventories across Wyoming have found Long-legged Myotis inhabiting sagebrush-steppe and grassland habitats with few or no trees, indicating that the species may utilize a broader range of habitat in Wyoming than previously thought [11-13]. In spring, summer, and fall, Long-legged Myotis roosts in a variety of structures during the day. These include dead and live trees, rock crevices, and human structures; but the species most frequently roosts in dead trees [3, 14, 15]. Specifically, both males and females of the species prefer to roost under the bark of moderately decayed snags that are taller than surrounding trees and that have a large diameter [16]. Males tend to roost singly and utilize a broader array of roost structures [17]. Females roost clonally in groups ranging from several individuals to several hundred individuals and almost exclusively roost in dead trees [16]. More specifically, at the stand level, female Long-legged Myotis preferred unfragmented forests with abundant snags and a relatively open overstory [14, 16, 18]. At the individual snag level, female Long-legged Myotis preferred to roost in tall, large, moderately decayed snags with a large amount of exfoliating bark [14, 18]. It is important to note that roost selection has not been evaluated in Wyoming, but, in general, roost selection patterns are similar in studies that occurred in a range of locations and forest types, suggesting that these findings are applicable to the Wyoming landscape. The species hibernates in winter, primarily in natural caves but also in abandoned mines. Little is known about what constitutes a suitable hibernation site or how the species selects microhabitat features within hibernacula.

Phenology:
The phenology of Long-legged Myotis in Wyoming is poorly understood. Across the species' range, phenology is highly variable, likely due to climatic variation [3]. Breeding occurs in fall, but the egg is not fertilized until spring when females emerge from hibernation. Females give birth to a single altricial pup between early May and early August following a 50- to 60-day gestation [19]. Pups are volant by late May to late August. The species hibernates during winter, but timing and duration of hibernation are not known [3, 16].

Diet:
Long-legged Myotis is strictly insectivorous. The species consumes a variety of insects across its range, but insects in the order Lepidoptera comprise the majority of its diet [3, 20, 21].

CONSERVATION CONCERNS

Abundance:
Continental: WIDESPREAD
Wyoming: COMMON
There are no robust estimates of abundance for Long-legged Myotis in Wyoming. The species is frequently documented during bat inventories across the state, often comprising a large proportion of the total number of bats detected [22-28]. This suggests that Long-legged Myotis is common in a variety of habitat types across Wyoming.

Population Trends:
Historic: UNKOWN
Recent: UNKNOWN
Both historic and recent population trends of Long-legged Myotis in Wyoming are unknown.

Intrinsic Vulnerability:
MODERATE VULNERABILITY
Long-legged Myotis has low fecundity, giving birth to one pup per year [3]. Long-legged Myotis hibernates in caves and abandoned mines during the winter, which are rare landscape features.

Extrinsic Stressors:
MODERATELY STRESSED
Long-legged Myotis hibernates in caves and abandoned mines during the winter, often in association with other bat species, including Little Brown Myotis and Northern Long-eared Myotis, which are known to be susceptible to the pathogenic fungus *Pseudogymnoascus destructans* (formerly *Geomyces destructans*) that causes White-nose Syndrome (WNS). The disease affects hibernating bats and has led to the death of millions of bats in eastern North America [29, 30]. Currently, the continental distribution of WNS does not overlap with the distribution of Long-legged Myotis [31], and it is unknown if Long-legged Myotis is susceptible to the disease. However, it is assumed that the distribution of WNS will continue to expand westward, and Long-legged Myotis could potentially experience declines in Wyoming and other portions of its range should WNS occur here. Disturbance from visitors to caves and abandoned mines used as hibernacula represents a significant threat to cave-roosting bats and bat habitat [19]. Even a small number of short duration disturbances lead to significant increases in arousal events and subsequent energy expenditures that may lead to increased mortality of Long-legged Myotis [32]. Throughout its range, Long-legged Myotis is generally associated with forest habitats. Any activities that alter forest structure may negatively impact the species. Specifically, because Long-legged Myotis roosts primarily in large dead trees in the summer, any timber management practices that reduces the number of these structures on the landscape may negatively affect local populations [15, 18, 21].

KEY ACTIVITIES IN WYOMING

Bats have received increasing research attention across North America and in Wyoming. To address concerns regarding potential WNS infection of bats in Wyoming, the Wyoming Game and Fish Department (WGFD) in cooperation with the Wyoming Bat Working Group authored "A strategic plan for white-nose syndrome in Wyoming" in 2011. This document presents a plan of action to minimize impacts of WNS if it is detected in Wyoming or adjacent states [33]. To facilitate early detection of the disease, WGFD requires researchers to evaluate all bats captured during research activities for signs of WNS infection using the Reichard Wing-Damage Index [34].

Beginning in 2012, WGFD personnel placed temperature and humidity loggers in a number of known or suspected hibernacula across Wyoming to determine if climatic conditions at these sites are favorable for growth of *P. destructans* [35, 36]. Personnel have also started collecting swabs of hibernating bats and hibernacula substrates in an effort to assist with early detection of *P. destructans*. Both WGFD and the Wyoming Natural Diversity Database (WYNDD) have conducted numerous bat inventories across the state including a statewide forest bat inventory from 2008 to 2011 [24-28, 37], a statewide inventory of cliffs, caves, and rock outcrops from 2012 to 2015 [22, 23], an inventory of bats at Devils Tower National Monument in 2010 and 2011, a bat monitoring effort in southern Wyoming from 2011 to 2013 [11, 12, 38], and bat surveys in northeastern Wyoming in 2014 and 2015 [39]. Long-legged Myotis was documented during all of these investigations [22, 23, 27, 28, 37, 40]; however, annual detections were low across southern Wyoming, likely because the majority of sample locations were not in suitable habitat. However, it is important to note that Long-legged Myotis was documented during both acoustic monitoring and mist-net surveys, indicating that the species may occur in other arid areas across the state [11, 12, 38]. In 2011, 2013, and 2015, WYNDD conducted multi-taxa inventories, which included bat surveys, within the Ferris Mountain Wilderness Study Area (WSA), Gardner Mountain WSA, and North Fork WSA. Several bat species were detected within these three WSAs including Long-legged Myotis [41, 42]. In 2015, WYNDD developed a bat monitoring plan and initiated survey activities at Bighorn Canyon National Recreation Area (BICA). The primary objective of this monitoring plan is to develop a baseline activity level or other index of abundance for Little Brown Myotis that can be used to detect changes in populations within BICA through time. During the first year of monitoring, Long-legged Myotis was documented at many sites across BICA. In addition to research, conservation organizations and federal and state agencies have developed outreach and education materials to inform the general public of the importance of bats and concerns regarding the persistence of bats in the future.

ECOLOGICAL INFORMATION NEEDS

While Long-legged Myotis is known to be associated with forested habitats, recent evidence indicates that the species occurs in other habitat types as well. A better understanding of the full breadth of habit use is needed. Phenology of the species in Wyoming is poorly understood and may be quite variable across the state depending on altitude and local climatic conditions. There is one known Long-legged Myotis hibernacula in Wyoming, and only one individual has been documented hibernating at this site, but, given the abundance and wide distribution of the species across the state, it is likely the species over-winters here in greater numbers than have been observed. Hibernacula are critical habitat components for many bat species and require systematic monitoring to better understand potential impacts and spread of WNS should it reach Wyoming. Robust estimates of abundance and population trends of the species in Wyoming do not exist, but would be valuable in the face of potential stressors such as WNS. While WNS has not been documented in Wyoming to date, continued monitoring for WNS across the state is necessary so that potential mitigation measures can be enacted in a timely manner.

MANAGEMENT IN WYOMING

This section authored solely by WGFD; Nichole L. Bjornlie. Very little is known about the wintering locations of Long-legged Myotis in Wyoming. Although WNS has not been detected in the state, the slow westward progression of the fungus necessitates the need for these data before it reaches Wyoming. Consequently, priorities will focus on locating and systematically

surveying hibernacula to monitor populations and recommend and assist with bat-friendly closures of important caves and mines where needed. In 2016, WGFD will begin a project in collaboration with the state of Nebraska to evaluate occurrence, abundance, and reproductive status of bats in eastern Wyoming, which represents an important zone of overlap between eastern and western bat species, including Long-legged Myotis. Mist-net surveys will continue to implement WNS protocols and assessment in an effort to assist with early detection should the fungus reach the state. Habitat assessments will be incorporated with survey efforts to better understand what influences species presence and distribution at a finer scale and to develop management and conservation recommendations. In addition to inventory projects, WGFD, in collaboration with the Wyoming Bat Working Group and other state-wide partners, will implement the North American Bat Monitoring Program that will use acoustic monitoring to assist with state and region-wide assessment of bat trends. Additional priorities will include updating and revising the Conservation Plan for Bats in Wyoming and the Strategic Plan for WNS in Wyoming. Finally, outreach and collaboration with private landowners will remain a priority to ensure conservation of bats and bat habitat.

CONTRIBUTORS

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REFERENCES

[1] NatureServe. (2015) NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1, http://explorer.natureserve.org, NatureServe, Arlington, Virginia.
[2] Wilson, D. E., and Reeder, D. M., (Eds.) (2005) *Mammal Species of the World. A Taxonomic and Geographic Reference (3rd ed)*, Johns Hopkins University Press.
[3] Warner, R. M., and Czaplewski, N. J. (1984) *Myotis volans*, *Mammalian Species*, 1-4.
[4] Adams, R. A. (2003) *Bats of the Rocky Mountain West: Natural History, Ecology, and Conservation*, University Press of Colorado, Boulder, Colorado.
[5] Kunz, T. H., and Anthony, E. L. P. (1982) Age estimation and postnatal-growth in the bat *Myotis lucifugus*, *Journal of Mammalogy 63*, 23-32.
[6] Orabona, A., Rudd, C., Grenier, M., Walker, Z., Patla, S., and Oakleaf, B. (2012) Atlas of birds, mammals, amphibians, and reptiles in Wyoming, p 232, Wyoming Game and Fish Department Nongame Program, Lander, WY.
[7] Grenier, M., Van Fleet, L., and Luce, B. (2002) Inventory of bats and bat habitat associated with caves and mines in Wyoming completion report, In *Threatened, endangered, and nongame bird and mammal investigations* (Cerovski, A. O., Ed.), pp 80-89, Wyoming Game and Fish Department Nongame Program, Lander, WY.
[8] Slough, B. G., Jung, T. S., and Lausen, C. L. (2014) Acoustic surveys reveal Hoary Bat (*Lasiurus cinereus*) and Long-legged Myotis (*Myotis volans*) in Yukon, *Northwestern Naturalist 95*, 176-185.
[9] Lausen, C. L., Waithaka, J., and Tate, D. P. (2014) Bats of Nahanni National Park Reserve and surrounding areas, Northwest Territories, *Northwestern Naturalist 95*, 186-196.
[10] Wilson, J. M., Reimer, J. P., Allaire, D., and Lausen, C. L. (2014) Diversity and distribution of bats in the Northwest Territories, *Northwestern Naturalist 95*, 197-218.
[11] Abernethy, I. M., Andersen, M. D., and Keinath, D. A. (2012) Bats of southern Wyoming: distribution and migration year 2 report. Prepared for the USDI Bureau of Land Management by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
[12] Abernethy, I. M., Andersen, M. D., and Keinath, D. A. (2014) Bats of southern Wyoming: distribution and migration year 3 report. Prepared for the USDI Bureau of Land Management by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

[13] Yandow, L., and Beard, L. (2015) Inventory of Bats Associated with Cliff and Canyon Habitats of Eastern Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., and Rudd, C. K., Eds.), pp 133-162, Wyoming Game and Fish Department.
[14] Arnett, E. B., and Hayes, J. P. (2009) Use of Conifer Snags as Roosts by Female Bats in Western Oregon, *Journal of Wildlife Management 73*, 214-225.
[15] Baker, M. D., and Lacki, M. J. (2006) Day-roosting habitat of female long-legged myotis in ponderosa pine forests, *Journal of Wildlife Management 70*, 207-215.
[16] Schmidt, C. A. (2003) Conservation assessment for the Long-legged Myotis in the Black Hills National Forest South Dakota and Wyoming, United States Forest Service Rocky Mountain Region Black Hills National Forest, Custer, South Dakota.
[17] Cryan, P. M., Bogan, M. A., and Yanega, G. M. (2001) Roosting habits of four bat species in the Black Hills of South Dakota, *Acta Chiropterologica 3*, 43-52.
[18] Lacki, M. J., Baker, M. D., and Johnson, J. S. (2010) Geographic Variation in Roost-Site Selection of Long-Legged Myotis in the Pacific Northwest, *Journal of Wildlife Management 74*, 1218-1228.
[19] Hester, S. G., and Grenier, M. B. (2005) A conservation plan for bats in Wyoming, Wyoming Game and Fish Department Nongame Program, Lander, WY.
[20] Ober, H. K., and Hayes, J. P. (2008) Prey selection by bats in forests of western Oregon, *Journal of Mammalogy 89*, 1191-1200.
[21] Johnson, J. S., Lacki, M. J., and Baker, M. D. (2007) Foraging ecology of long-legged myotis (Myotis volans) in north-central Idaho, *Journal of Mammalogy 88*, 1261-1270.
[22] Yandow, L., and Grenier, M. (2014) Inventory of Bats Associated with Cliff and Canyon Habitats of Western Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., and Cudworth, N., Eds.), pp 253-284, Wyoming Game and Fish Department.
[23] Abel, B., and Grenier, M. (2013) Inventory of Bats in Cliffs and Canyons of Western Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A., Ed.), pp 234-265, Wyoming Game and Fish Department.
[24] Abel, B., and Grenier, M. (2012) Inventory of Bats in Forests of Southeastern Wyoming: Acoustic Surveys, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Abel, B., and Cudworth, N., Eds.), pp 155-181, Wyoming Game and Fish Department.
[25] Abel, B., and Grenier, M. (2012) Inventory of Bats in Forests of Southeastern Wyoming: Mist Netting, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Abel, B., and Cudworth, N., Eds.), pp 125-154, Wyoming Game and Fish Department.
[26] Cudworth, N., Johnson, S., and Grenier, M. (2011) Inventories of Forest Bats in Northeastern Wyoming: Mist Netting, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Ed.), pp 119-145, Wyoming Game and Fish Department.
[27] Johnson, S., and Grenier, M. (2010) Forest Bat Inventories: Anabat Acoustic Surveys, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., Ed.), pp 145-161, Wyoming Game and Fish Department.
[28] Johnson, S., and Grenier, M. (2010) Forest Bat Inventories: Mist Netting, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., Ed.), pp 162-182, Wyoming Game and Fish Department.
[29] Francl, K. E., Ford, W. M., Sparks, D. W., and Brack, V., Jr. (2012) Capture and Reproductive Trends in Summer Bat Communities in West Virginia: Assessing the Impact of White-Nose Syndrome, *Journal of Fish and Wildlife Management 3*, 33-42.
[30] Ingersoll, T. E., Sewall, B. J., and Amelon, S. K. (2013) Improved Analysis of Long-Term Monitoring Data Demonstrates Marked Regional Declines of Bat Populations in the Eastern United States, *PLoS ONE 8*, e65907-e65907.
[31] White-nose Syndrome.org. (2015) White-nose Syndrome.org A coordinated response to the devastating bat disease, http://whitenosesyndrome.org/.
[32] Boyles, J. G., and Brack, V., Jr. (2009) Modeling survival rates of hibernating mammals with individual based models of energy expenditure, *Journal of Mammalogy 90*, 9-16.
[33] Abel, B., and Grenier, M. (2011) A strategic plan for White-nose Syndrome in Wyoming, p 27, Wyoming Game and Fish Department, Lander, Wyoming.

[34] Reichard, J. D., and Kunz, T. H. (2009) White-nose syndrome inflicts lasting injuries to the wings of little brown myotis (Myotis lucifugus), *Acta Chiropterologica 11*, 457-464.
[35] Beard, L. (2015) Surveillance of hibernating bats and environmental conditions at caves and abandoned mines in Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., and Rudd, C. K., Eds.), pp 163-193, Wyoming Game and Fish Department.
[36] Beard, L. (2016) Surveillance of Hibernating Bats and Environmental Conditions at Caves and Abandoned Mines in Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., Ed.), pp 97-113, Wyoming Game and Fish Department.
[37] Filipi, T., Grenier, M., Chrisman, S., and Hannelly, E. (2009) Forest Bat Inventories, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A., Ed.), pp 123-135, Wyoming Game and Fish Department.
[38] Griscom, H. R., Andersen, M. D., and Keinath, D. A. (2012) Bats of southern Wyoming: Distribution & Migration. Year 1 report. Prepared for the USDI Bureau of Land Management by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
[39] Abernethy, I. M., Andersen, M. D., and Keinath, D. A. (2015) Bats of Wyoming: distribution and migration year 4 report. Prepared for the USDI Bureau of Land Management by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
[40] Griscom, H. R., and Keinath, D. A. (2012) Inventory and status of bats at Devils Tower National Monument, p 34, Report prepared for the USDI National Park Service by the Wyoming Natural Diveristy Database - University of Wyoming, Laramie, WY.
[41] Estes-Zumpf, W., and Keinath, D. (2011) Inventory of sensitive animal species in the Ferris Mountain Wilderness Study Area, Wyoming, Wyoming Natural Diversity Database, Laramie, Wyoming.
[42] Estes-Zumpf, W., Tronstad, L., Abernethy, I., Keinath, D., Handley, J., and Walker, J. (2014) Inventory and monitoring of sensitive species in the Gardner Mountain Wilderness Study Area, Wyoming. Prepared for the National Landscape Conservation System Research and Science Program and the Bureau of Land Management Buffalo Field Office by the Wyoming Natural Diversity Database, Laramie, Wyoming.

Figure 1: Adult Long-legged Myotis. (Photo courtesy of Robert J. Luce)

Figure 2: North American range of *Myotis volans*. (Map from: Patterson, B. D., et al. (2007) Digital Distribution Maps of the Mammals of the Western Hemisphere, version 3.0, NatureServe, Arlington, Virginia.)

Figure 3: Mixed montane forest where Long-legged Myotis was documented in the Bighorn Mountains, Wyoming. (Photo courtesy of Ian M. Abernethy)

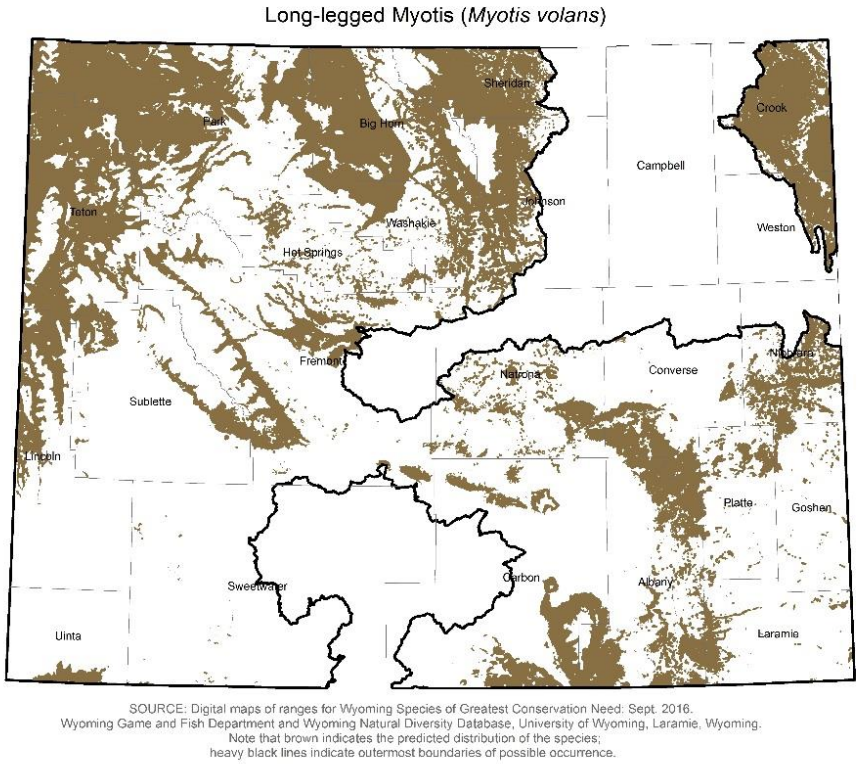

Figure 4: Range and predicted distribution of *Myotis volans* in Wyoming.