Little brown myotis

Myotis lucifugus

Class: Mammalia
Order: Chiroptera

Review Status: Peer-reviewed **Version Date:** 19 December 2017

Conservation Status

NatureServe:	*Agency:*		
G Rank: G3	ADF&G: Species of Greatest Conservation Need	IUCN: Least Concern	Audubon AK:
S Rank: S3	USFWS:	BLM: Watch	

Final Rank

Conservation category: **V. Orange**

unknown status and either high biological vulnerability or high action need

Category	Range	Score
Status	-20 to 20	0
Biological	-50 to 50	-25
Action	-40 to 40	8

Higher numerical scores denote greater concern

Status - variables measure the trend in a taxon's population status or distribution. Higher status scores denote taxa with known declining trends. Status scores range from -20 (increasing) to 20 (decreasing). **Score**

Population Trend in Alaska (-10 to 10) 0

No population trends are available for Alaska. Elsewhere in North America, populations have declined dramatically since the appearance of white-nose syndrome (WNS) in 2006 (Frick et al. 2010a). WNS has not been detected in Alaska, but was confirmed in Washington in March 2016 (https://www.usgs.gov/news/bat-white-nose-syndrome-confirmed-washington-state).

Distribution Trend in Alaska (-10 to 10) 0

Unknown.

Status Total: 0

Biological - variables measure aspects of a taxon's distribution, abundance and life history. Higher biological scores suggest greater vulnerability to extirpation. Biological scores range from -50 (least vulnerable) to 50 (most vulnerable). **Score**

Population Size in Alaska (-10 to 10) -10

>25,000. Surveys in July 2016 counted ~1,100 adult females residing at six maternity colonies along the Copper River basin (Reimer et al. 2016) and 87 maternity colonies are reported in the ACCS Wildlife Data Portal (ACCS 2017a). Multiple counts in 2013 and 2014 documented >1,000 breeding females in Juneau alone (K. Blejwas, ADF&G, unpublished data). Given the number of known maternity colonies in the state and assuming an average roost size of 150 females, there are at least 14,000 adult females breeding in Alaska, and at least twice that number when considering adult males and juveniles that are not counted during maternity roost surveys.

Range Size in Alaska (-10 to 10) -10

In the summer, widely distributed throughout the state from southeast to northern Alaska. Records at the northern distributional limit include: Minto Lake (65.6°N, confirmed sighting), Wiseman (67.4°N, confirmed; ARCTOS 2016), and Wainwright (70.6°N; Shively and Barboza 2017). Observations have also been reported as far west as Kotzebue, St. Michael, and the Semidi Islands (Tessler et al. 2014a). Their winter distribution in Alaska is unknown. Estimated summer range size is >400,000 sq. km (ACCS 2017a).

Population Concentration in Alaska (-10 to 10) -10

Given distribution and population size, number of sites is likely >250. In the summer, adult females and their pups concentrate at maternity colonies. Counts at maternity colonies range from 1 to 1,340 bats (Reimer et al. 2016; K. Blejwas, unpublished data). 48 maternity colonies have been reported by citizen scientists through the Alaska Bat Monitoring Program (Tessler et al. 2014a) and 87 maternity colonies are listed in the ACCS Wildlife Data Portal (ACCS 2017a). It is likely that there are many more maternity colonies that have not been reported across the state. The behavior of little brown myotis during winter in interior Alaska is unknown, however, radio telemetry studies in southeast Alaska suggest that bats overwinter in small numbers in holes in scree fields and in root wads of trees or stumps (K. Blejwas, unpublished data).

Reproductive Potential in Alaska

Age of First Reproduction (-5 to 5) -5

Can potentially give birth within their first year if they are in good enough body condition, but reproduction may be delayed until their second year in colder climates (Nagorsen and Brigham 1993; Frick et al. 2010b).

Number of Young (-5 to 5) 4

Females give birth to a single pup, but may not reproduce every year if resources are scarce or if they are in poor body condition (Nagorsen and Brigham 1993; Frick et al. 2010b). The proportion of females that forego reproduction in a given year is unknown. To reflect this uncertainty, we rank this question as 0.5 * A + 0.5 * B.

Ecological Specialization in Alaska

Dietary (-5 to 5) 1

Opportunistic insectivore. Consumes a variety of prey that changes seasonally with availability (Belwood and Fenton 1976; Clare et al. 2011). Prey items include mosquitoes, midges, caddisflies, moths, various hoppers, smaller beetles, and spiders (Whitaker and Lawhead 1992; Clare et al. 2011; Shively et al. 2017; Kaupas and Barclay 2018). In interior Alaska, little brown bats have a broad dietary niche and prey on moths, flies, wasps, and mosquitoes; a large proportion of their diet (up to 50%) is also comprised of spiders (Boyles et al. 2016; Shively et al. 2017). Because invertebrates are an ephemeral and potentially unpredictable food source, we rank this question as B- Moderately adaptable with key requirements common.

Habitat (-5 to 5) 5

In Alaska, found in a variety of habitat types and elevations, including coniferous and deciduous forests, urban areas, and alpine areas up to 1280 m (Parker et al. 1996; Olson and Fiely 2014; Tessler et al. 2014a; Faust 2018). Forages near riparian areas and sites with open water (Barclay 1991; Parker et al. 1996; Boland et al. 2009a). Males and non-reproductive females roost in tree cavities and under bark, in rock crevices, caves, cliffs, hot springs, and buildings (Fenton and Barclay 1980; West and Swain 1999; Olson and Fiely 2014; Shively and Barboza 2017). Sites with warm ambient temperatures are required for hibernation sites and reproductive females (Vonhof and Barclay 1996; Humphries et al. 2002). In interior and western Alaska, maternity colonies have only been reported from anthropogenic structures (Tessler et al. 2014a; Reimer et al. 2016) and

almost exclusively from buildings in southeast Alaska (Olson and Fiely 2014; K. Blejwas, unpublished data). Human structures may also be exclusively used for hibernacula sites in interior Alaska and further north (Shively and Barboza 2017). In southeast Alaska, radio telemetry studies suggest that bats overwinter in small numbers in holes in scree fields and in root wads of trees or stumps (K. Blejwas, unpublished data).

Biological Total: -25

Action - variables measure current state of knowledge or extent of conservation efforts directed toward a given taxon. Higher action scores denote greater information needs due of lack of knowledge or conservation action. Action scores range from -40 (lower needs) to 40 (greater needs). **Score**

Management Plans and Regulations in Alaska (-10 to 10) 2

Bats may be intentionally killed by humans when they are perceived as nuisance or disease-carrying species. In Alaska, state laws prohibit the killing of nuisance animals unless a permit is obtained (5 AAC 92.420. Taking nuisance wildlife). This species is currently on the Seven-Year Workplan for listing under the U.S. Endangered Species Act (https://www.fws.gov/endangered/what-we-do/listing-workplan.html).

Knowledge of Distribution and Habitat in Alaska (-10 to 10) 2

Distribution and broad habitat associations have been captured by surveys in southeast Alaska (Parker 1996; http://www.adfg.alaska.gov/index.cfm?adfg=citizenscience.batsacousticresults), southcoastal (Boland et al. 2009a; Faust 2018), southcentral (Loeb et al. 2014; Reimer et al. 2016), and interior (Reimer et al. 2016; Shively and Barboza 2017). Bats have also been reported from northern and western Alaska (Tessler et al. 2014a; Shively and Barboza 2017), though the extent to which these areas are being used is unknown. Most importantly, the winter distribution and habitat use of little brown myotis is largely unknown (Tessler et al. 2014a). Surveys in Southeast indicate that this species likely overwinters in Alaska, at least in the southern part of the state (K. Blejwas, unpub. data), but additional work is needed to find hibernacula.

Knowledge of Population Trends in Alaska (-10 to 10) 2

The Alaska Bat Monitoring Program collects bat observations from the public with the goal of documenting species' summer distribution, roosting habitat, migration patterns, and winter hibernacula. Bats in southeast Alaska are currently being monitored by ADF&G using driving surveys (conducted by citizen scientists) and a network of year-round acoustic monitoring stations. From 2016 to 2018, population monitoring was conducted at maternity colonies in interior and southcentral Alaska (Reimer et al. 2016; J. P. Reimer, ACCS, unpub. data). Because these monitoring programs are still in their infancy, data are not yet adequate to detect statewide population trends (J. P. Reimer, ACCS, pers. comm.).

Knowledge of Factors Limiting Populations in Alaska (-10 to 10) 2

In eastern North America, this species is highly vulnerable to mortality from white-nose syndrome (WNS) (Frick et al. 2010a). Preliminary data suggest that individuals in Alaska may not aggregate in large numbers during winter (K. Blejwas, unpub. data) and Alaskan populations may be isolated from affected populations elsewhere in North America (Vonhof et al. 2015). Collectively, these features would make little brown bats less susceptible to WNS; however, more research is needed on the migration and hibernation ecology of little brown bats in Alaska. The northern limit of their range is thought to be dictated by the availability of sites with warm, stable temperatures for hibernacula and maternity colonies (Tessler et al. 2014a; Shively and Barboza 2017). In central and northern Alaska, they may be entirely dependent on human settlements for maternity colonies and hibernation sites (Shively and Barboza 2017). Little brown bats at northern latitudes also appear to eat more non-aerial prey (e.g. spiders), which may allow them to meet energetic requirements even in inclement or cold weather (Boyles et al. 2016; Shively et al. 2017; Kaupas and Barclay 2018).

Additional research is needed to understand the effects of forest disturbances (Parker et al. 1996; Patriquin and Barclay 2003; Randall et al. 2011), prey availability, and weather (Burles et al. 2009; Frick et al. 2010b) on foraging activity, reproduction, and survival in Alaska.

Action Total: 8

Supplemental Information - variables do not receive numerical scores. Instead, they are used to sort taxa to answer specific biological or management questions.

Harvest:	None or Prohibited
Seasonal Occurrence:	Year-round
Taxonomic Significance:	Monotypic species
% Global Range in Alaska:	<10%
% Global Population in Alaska:	<25%
Peripheral:	No

References

Alaska Center for Conservation Science (ACCS). 2017a. Wildlife Data Portal. University of Alaska Anchorage. Available online: http://aknhp.uaa.alaska.edu/apps/wildlife

ARCTOS. 2016. ARCTOS database: Fish, amphibian, mammal, bird and reptile collections. University of Alaska Museum of the North, Fairbanks, AK, USA. Available online: http://arctos.database.museum/

Barclay, R. M. R. 1991. Population structure of temperate zone insectivorous bats in relation to foraging behaviour and energy demand. Journal of Animal Ecology 60(1):165-178. DOI: 10.2307/5452

Belwood, J. J., and M. B. Fenton. 1976. Variation in the diet of Myotis lucifugus (Chiroptera: Vespertilionidae). Canadian Journal of Zoology 54(10):1674–1678. DOI: 10.1139/z76-194

Boland, J. L., W. P. Smith, and J. P. Hayes. 2009a. Survey of bats in Southeast Alaska with emphasis on Keen's myotis (Myotis keenii). Northwest Science 83(3):169-179. DOI: 10.3955/046.083.0301

Boyles, J. G., L. P. McGuire, E. Boyles, J. P. Reimer, C. A. C. Brooks, R. W. Rutherford, T. A. Rutherford, J. O. Whitaker Jr., and G. F. McCracken. 2016. Physiological and behavioral adaptations in bats living at high latitudes. Physiology & Behavior 165:322-327. DOI: 10.1016/j.physbeh.2016.08.016

Burles, D. W., R. M. Brigham, R. A. Ring, and T. E. Reimchen. 2009. Influence of weather on two insectivorous bats in a temperate Pacific Northwest rainforest. Canadian Journal of Zoology 87(2):132–138. DOI: 10.1139/Z08-146

Clare, E. L., B. R. Barber, B. W. Sweeny, P. D. N. Hebert, and M. B. Fenton. 2011. Eating local: Influences of habitat on the diet of little brown bats (Myotis lucifugus). Molecular Ecology 20(8):1772-1780. DOI: 10.1111/j.1365-294X.2011.05040.x.

Faust, J. L. 2018. Bat activity and distribution in coastal southcentral Alaska: Copper River Delta. MSc thesis, University of Alaska Anchorage, AK, USA.

Fenton, M. B., R. M. R. Barclay. 1980. Myotis lucifugus. Mammalian Species 142:1-8. DOI: 10.2307/3503792

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. 2010a. An emerging disease causes regional population collapse of a common North American bat species. Science 329(5992):679–682. DOI: 10.1126/science.1188594

Frick, W. F., D. S. Reynolds, and T. H. Kunz. 2010b. Influence of climate and reproductive timing on demography of little brown myotis Myotis lucifugus. Journal of Animal Ecology 79(1):128-136. DOI: 10.1111/j.1365-2656.2009.01615.x

Humphries, M. M., D. W. Thomas, and J. R. Speakman. 2002. Climate-mediated energetic constraints on the distribution of hibernating mammals. Nature 418(6895):313–316. DOI: 10.1038/nature00828

Kaupas, L. A., and R. M. R. Barclay. 2018. Temperature-dependent consumption of spiders by little brown bats (Myotis lucifugus), but not northern long-eared bats (Myotis septentrionalis), in northern Canada. Canadian Journal of Zoology

96(3):261–268. DOI: 10.1139/cjz-2017-0123

Kunz, T.H., and J. D. Reichard. 2010. Status review of the little brown myotis (Myotis lucifugus) and determination that immediate listing under the Endangered Species Act is scientifically and legally warranted. Final report, Center for Ecology and Conservation Biology, Boston University, Boston, MA, USA.

Loeb, S.C., E. A. Winters, M. E. Glaser, M. L. Snively, K. S. Laves, and J. K. Ilse. 2014. Observations of little brown myotis (Myotis lucifugus) habitat associations and activity in the Chugach National Forest, Alaska. Northwestern Naturalist 95(3):264-276. DOI: 10.1898/13-04.1

Nagorsen, D. W., and R. M. Brigham. 1993. Bats of British Columbia. UBC Press, Vancouver, BC, CAN.

Olson, L. E., and J. L. Fiely. 2014. Bats of KLGO and the Taiya Inlet Watershed: Survey results 2013-2014, with notes on habits and roosts. Natural Resource Data Series, National Park Service, Fort Collins, CO, USA. Available online: https://irma.nps.gov/DataStore/

Parker, D. I. 1996. Forest ecology and distribution of bats in Alaska. MSc thesis, University of Alaska Fairbanks, AK, USA.

Parker, D. I., J. A. Cook, and S. W. Lewis. 1996. Effects of timber harvest on bat activity in southeastern Alaska's temperate rainforest. Pages 277-292 in Barclay, R. M. R., and R. M. Brigham, eds. Proceedings of the Bats and Forests Symposium, October 19-21 1995, Victoria, BC, Canada. Working paper 23/1996, Research Branch, BC Ministry of Forests, Victoria, BC, CAN. Available online: https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp23.htm

Patriquin, K. J., and R. M. R. Barclay. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. Journal of Applied Ecology 40(4):646–657. DOI: 10.1046/j.1365-2664.2003.00831.x

Randall, L. A., R. M. R. Barclay, M. L. Reid, and T. S. Jung. 2011. Recent infestation of forest stands by spruce beetles does not predict habitat use by little brown bats (Myotis lucifugus) in southwestern Yukon, Canada. Forest Ecology and Management 261(11):1950–1956. DOI: 10.1016/j.foreco.2011.02.021

Reimer, J. P., L. A. Kaupas, and P. A. Schuette. 2016. Little brown myotis maternity roost surveys: Copper River basin, 2016. Final report, Alaska Center for Conservation Science, University of Alaska Anchorage, AK, USA. Available online: https://accs.uaa.alaska.edu/publications/

Shively, R., and P. Barboza. 2017. Range and roosting ecology of the little brown bat, Myotis lucifugus, in interior and northern Alaska. Northwestern Naturalist 98(2):122-131. DOI: 10.1898/NWN16-16.1

Shively, R., P. Barboza, P. Doak, and T. S. Jung. 2018. Increased diet breadth of little brown bats (Myotis lucifugus) at their northern range limit: A multimethod approach. Canadian Journal of Zoology 96(1):31–38. DOI: 10.1139/cjz-2017-0017

Tessler, D. F., M. L. Snively, and T. A. Gotthardt. 2014a. New insights on the distribution, ecology, and overwintering behavior of the little brown myotis (Myotis lucifugus) in Alaska. Northwestern Naturalist 95(3):251–263. DOI: 10.1898/13-12.1

Vonhof, M. J., and R. M. R. Barclay. 1996. Roost-site selection and roosting ecology of forest-dwelling bats in southern British Columbia. Canadian Journal of Zoology 74(10):1797–1805. DOI: 10.1139/z96-200

Vonhof, M. J., A. L. Russell, and C. M. Miller-Butterworth. 2015. Range-wide genetic analysis of little brown bat (Myotis lucifugus) populations: Estimating the risk of spread of white-nose syndrome. PLoS ONE 10(7):e0128713. DOI: 10.1371/journal.pone.0128713

West, E. W., and U. Swain. 1999. Surface activity and structure of a hydrothermally-heated maternity colony of the little brown bat, Myotis lucifugus, in Alaska. Canadian Field-Naturalist 113(3):425-429.

Whitaker, J. O. Jr. and B. Lawhead. 1992. Foods of Myotis lucifugus in a maternity colony in central Alaska. Journal of Mammalogy 73(3):646-648. DOI: 10.2307/1382037