Species Status Assessment

For

Northern long-eared bat (*Myotis septentrionalis*)

Joseph A. Kath
Illinois Department of Natural Resources
Division of Natural Heritage

June 2022

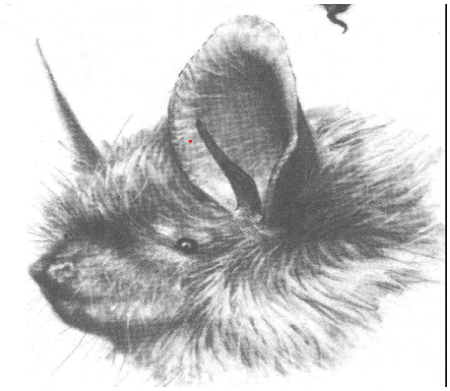
Section 1. Species Description and Conservation Status

Taxonomy

Myotis septentrionalis, known as the northern long-eared bat or northern myotis, is a species of bat native to North America (Whitaker and Hamilton 1998). *Myotis septentrionalis* originally was considered a subspecies of *M. keenii* (Fitch and Shump 1979) until van Zyll de Jong (1979) proposed division of *M. keenii* into two distinct species. Manning (1993) suggested that *M. keenii* and *M. septentrionalis* are sister species, whereas van Zyll de Jong and Nagorsen (1994) argued that *M. evotis* and *M. septentrionalis* are sister species, based on external and cranial characteristics. *Myotis* is derived from the Greek for "mouse eared." *Septentrionalis* comes from the Latin for "northern" (Nagorsen and Brigham 1993). Other common names for this species are northern bat (Foster and Kurta 1999) and northern myotis (Jones et al. 1997).

Physical Characteristics

The northern long-eared bat is a medium-sized bat, with relatively long ears with a long, sharply pointed tragus (fleshy projection in the ear). The pelage is dull brown on the back and pale grayish brown on the underside. The membranes are dark and the calcar (a bone or cartilage growth from the ankle that helps to support the tail membrane in flight) is slightly keeled (Whitaker 2010). Adults typically measure 7.8-9.5 cm (3.1-3.7 in.) in total body length, with a tail length of 3.2-3.4 cm (1.2-1.3 in.). Weights range from 5.0-6.4 g (0.18-0.23 oz.) (Hazard 1982). The northern long-eared bat can be distinguished from the little brown bat (*Myotis lucifugus*) by its long ears and pointed tragi. When folded forward, the northern long-eared bats' ears extend at least 3 mm (0.12 in.) beyond its nose. The ears of the little brown Myotis, on the other hand, are even with or only barely extend past the tip of the nose, and the tragi are shorter and blunted (Hofmann 2008).



Above: Long ears and slender, pointed tragus of *M. septentrionalis* (left and center); Even ears and broad, blunt tragus of *M. lucifugus* (right). Below: *M. lucifugus* tragus (left); *M. septentrionalis* tragus (right).

Figure 1. The asymmetrical tragus of the little brown bat (left), and the symmetrical, spear-like tragus of the northern long-eared bat (right). Dave Redell, Wisconsin DNR

The northern long-eared bat may also be confused with the Indiana bat (*Myotis sodalis*), but the two can be distinguished much the same way as the little brown bat from the northern long-eared bat. The Indiana bat's keeled calcar, a spur of cartilage extended from the ankle and supporting the interfemoral membrane, is a distinguishing feature that the northern long-eared bat lacks (Barbour and Davis 1969; Hoffmeister 1989).

Life History/Ecology

Female and male northern long-eared bats emerge from hibernation in April and May. In summer, the northern long-eared bat roosts alone, or females may form a colony with other females. The northern long-eared bat chooses day roosts in tall trees and snags. Night roosts for this species include caves and rock shelters where they rest between feeding bouts (Caceres and Barclay 2000; Kurta 1995). Roost fidelity is low and individual bats switch roosts approximately every two days in the summer (Foster and Kurta 1999; WDNR 2009). This species is a relatively long lived mammal for its size and usually lives up to 8-10 years. Banding records indicated a northern long-eared bat caught in the wild lived up to 18 years (Caceres and Barclay 2000). In the fall, northern long-eared bats will make short migrations from summer habitat to winter hibernacula (caves and abandoned mines) (Caceres and Barclay 2000; Hazard 1982).

Northern long-eared bat habitat use changes over the course of the year and varies based on sex and reproductive status. Reproductive females often use different summer habitat from both males and non-reproductive females.

- Summer: Northern long-eared bats commonly roost in trees but have been known to roost in man-made structures. This species often roosts under bark close to the tree trunk, or in crevices of tree species such as maples, oaks, and ashes (Foster and Kurta 1999). Northern long-eared bats prefer to roost in tall trees with a dynamic forest structure including old growth and some young trees (Foster and Kurta 1999). Females form small maternity colonies which are commonly located in trees, but also occur under shingles and in man-made structures like bat houses and buildings. Northern long-eared bats commonly forage within the forest and below the canopy mainly in upland forests on hillsides and ridges (Owen et al. 2003), but have also been noted to forage along paths, ponds, streams, and at forest edges. Foster and Kurta (1999) found all roost trees to be close to wetlands.

- Home range: Owen et al. (2003) found that in West Virginia northern long-eared bats use approximately 150 acres for their home range in summer and similarly Yates et al. (2014) found northern long-eared bats using approximately 250 acres for their home range. Home ranges can also change based on reproductive status. As with other Myotis species, Lacki et al. (2009) found that female northern long-eared bats had a larger home range when pregnant (289 acres) compared to lactating females (45.9 acres).

- Winter: The northern long-eared bat hibernates in caves and abandoned mines in winter and tends to be found in deep crevices (Kurta 1995; Caceres and Barclay 2000). *Myotis septentrionalis* will return to the same hibernaculum although not always in sequential seasons. Individuals generally hibernate with large numbers of bats of other species, particularly *M. lucifugus, Eptesicus fuscus,* and *Perimyotis subflavus*, but M. *septentrionalis* usually forms a small proportion of the total hibernating population (Caire et al. 1979; Griffin 1940; Hitchcock 1949; Mills 1971).

M. septentrionalis may move between hibernacula throughout winter (Griffin 1940; Whitaker and Rissler 1992), which may affect population estimates and also makes it difficult to survey and monitor for this species during the winter (Caceres and Barclay 2000; Laubach et al. 1984).

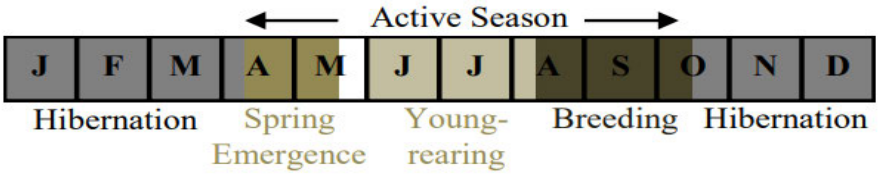
Typical cluster size of hibernating *M. septentrionalis*; Common summer roosts located under tree bark or in crevices of hardwoods such as maple, oak, and ash species.

Edge habitat is important for northern long-eared bats as they migrate and forage. When bats migrate from wintering caves to summer habitat or commute from roosts to feeding grounds, they move through the landscape in a manner that protects them from wind and predators. Instead of flying the shortest distance across a field, bats will take longer routes that follow edge habitat. In addition to offering protection, this behavior may also allow bats more feeding opportunities because food is more abundant around edge habitat (Limpens and Kapteyn 1991). Commuting along edge habitat may assist the bats with navigation and orientation through use of linear edges as landmarks (Verboom and Huitema 1997).

Reproduction

Bats in the family Vespertilionidae ('vesper bats' or 'evening bats') display delayed fertilization, where mating takes place in fall; ovulation and fertilization do not occur until spring. Overall, females bear a single offspring in June or July [see ACTIVE SEASON graphic below]. The earliest-born young are usually able to fly by early July and the nursery colonies disband around this time (Nordquist and Birney 1985). Females form small maternity colonies of up to 30 bats in late spring and females give birth to a single pup in June or early July (Caceres and Barclay 2000; Owen et al. 2002). Pups are born hairless and flightless. The pup nurses for about a month and is left at the roost nightly while the mother goes out to feed.

The pup begins to fly and explore on its own at four to six weeks. Maternity colonies disperse shortly after young are volant and bats move closer to hibernacula in the fall and mate before they hibernate. Young of the year do not usually mate, but some juvenile males appear reproductively active (WDNR 2009).



Diet

The northern long-eared bat is insectivorous and prey includes moths (Lepidoptera), flies (Diptera) and beetles (Coleoptera). This species is commonly referred to as a gleaning bat because it often catches insects that are at rest on leaves or twigs, in addition to catching insects that are flying (Lee and McCracken 2004). *Myotis septentrionalis* uses frequency modulated (FM) echolocation calls of a higher frequency (126-60 kHz), shorter duration (1.01 ms), broader bandwidth, and lower intensity (78 dB) than other *Myotis* species, which only aerial hawk (Faure et al. 1993). Calls exhibit a sharp FM sweep, which is almost linear over time (Fenton et al. 1983; Miller and Treat 1993). High-frequency, low intensity *M. septentrionalis* calls may be relatively inaudible to prey such as some moths and lacewings (Faure et al. 1993).

Global, federal, regional, and state conservation status of the Northern long-eared bat

Assessment	**Status**
Global Rank (G-rank)	G1G2 (Critically imperiled/Imperiled)
Midwest Species of Greatest Conservation Need	Yes
State Rank (S-rank), 2021	No status rank (SNR)
Illinois Conservation Status	Not listed
Federal Conservation Status	Currently Threatened with Federal ESA 4(d) Rule. Proposed rule to reclassify as Endangered published in *Federal Register* on 03/23/2022. Final USFWS decision TBA in November 2022.

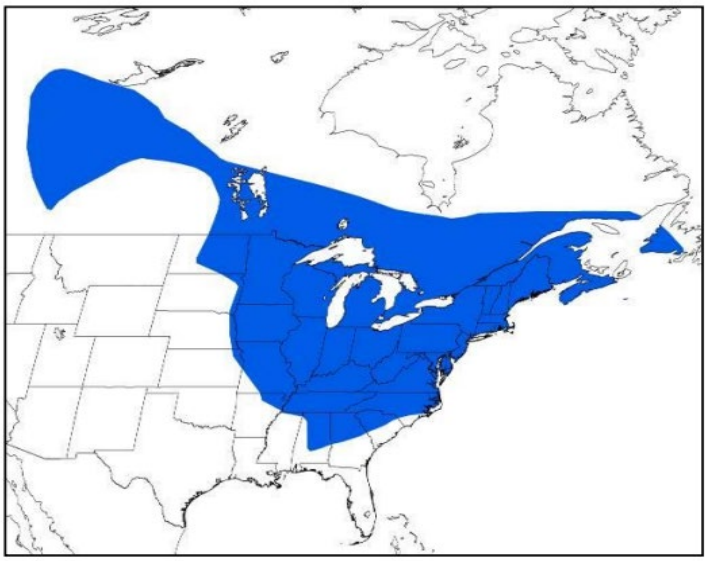
Section 2. Distribution Estimate

Historic Range

The northern long-eared bat was widely distributed in the eastern United States and Canada, with the exception of the very southeastern United States and Texas. Overall, it is found in 37 states and eight provinces in North America. This all changed with the discovery of White-nose syndrome (WNS).

WNS is caused by the fungus, *Pseudogymnoascus destructans(Pd)*, that infects skin of the muzzle, ears, and wings of hibernating bats. Field signs of WNS can include excessive or unexplained mortality at a hibernaculum; visible white fungal growth on the muzzle or wings of live or freshly dead bats; abnormal daytime activity during winter months or movement toward hibernacula openings; and severe wing

damage in bats that have recently emerged from hibernation. Infected bats experience a cascade of physiologic changes that result in weight loss, dehydration, electrolyte imbalances, and death (USGS-NWHC 2016/2022).



Historic range of the northern long-eared bat – pre WNS.

Current Range

White-nose syndrome (WNS) has killed over 90% of northern long-eared, little brown, and tricolored bat populations in fewer than 10 years, according to a study recently published in Conservation Biology. Researchers also noted declines in Indiana bat and big brown bat populations.

WNS is a disease that affects hibernating bats and is caused by an invasive, cold-loving fungus. The fungus grows on bats' skin, disturbing their hibernation and resulting in dehydration, starvation and often death. First documented in New York in 2006, WNS has since spread to 35 states and seven Canadian provinces and has been confirmed in 12 North American bat species (USGS C&P Database 2021). Scientists are tracking tricolored bat populations across their historic range and an updated species distribution map is anticipated within the next 12-24 months – via the USFWS.

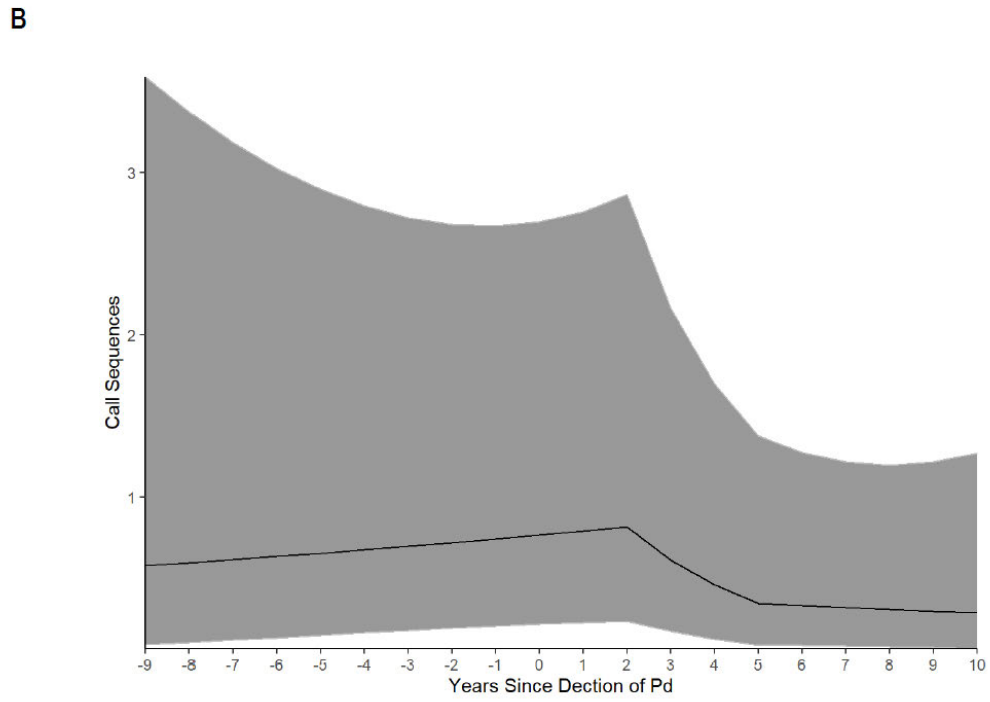
Hibernating northern long-eared bats exhibiting WNS.

FROM: *Analytical Assessments in Support of the U.S. Fish and Wildlife Service 3-Bat Species Status Assessment – January 2022*

Bat activity recorded during mobile acoustic transects provides an index of abundance and can be used to determine changes in populations over time. Mobile acoustic transects in Europe have revealed that a ~3% annual decline of common bat species is detectable within 5-8 years given modest sampling effort. For species rarely detected (~ 1.8 passes per transect), it may take 10-15 years to detect a 2.5% annual decline by mobile transect surveys. A recent study using a subset of mobile transect monitoring data provided to the SSA found substantial declines in relative abundance for both *Myotis lucifugus* and *Perimyotis subflavus*. Therefore, we/NABat expect that mobile transect surveys should be able to detect large changes in populations for *Myotis lucifugus, Myotis septentrionalis,* and *Perimyotis subflavus* over the past decade related to the main stressor on North American hibernating bat populations, the emergence of white-nose syndrome (WNS).

Response to *Pd* Year of Arrival

The count of call sequences of *Myotis lucifugus, Myotis septentrionalis*, *Perimyotis subflavus* along mobile transects all declined steeply within 2-4 years of the predicted arrival of *Pd*. Four years after the arrival of *Pd*, declines for *Myotis lucifugus* and *Myotis septentrionalis* appear shallower as the predicted number of calls sequences per transect approach zero.



Relationship between years since detection of *Pseudogymnoascus destructans (Pd)* and activity of *Myotis septentrionalis* along mobile acoustic transects. Plots are generated with all covariates, except year since *Pd* detection (*Pd* YSD), held at their mean.

Rate of Change (λ) across the Species Range in the United States

We calculated predicted counts in call sequences across the species range within the minimum and maximum latitude and longitude sampled for each species. Call sequences of *Myotis septentrionalis* were predicted to decline from a median of 0.11 calls per transect in 2009 to 0.02 calls per transect in 2020, a decline of 79% across most of the species' range in the United States.

State	Statistic	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Illinois	Annual Lambda	NA	0.74	0.71	0.68	0.74	0.72	0.66	0.86	0.78	0.76	0.81	0.88
Illinois	Cumulative Lambda	1.00	0.74	0.53	0.37	0.27	0.19	0.13	0.11	0.09	0.07	0.06	0.05
Illinois	Median Activity	0.05	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00

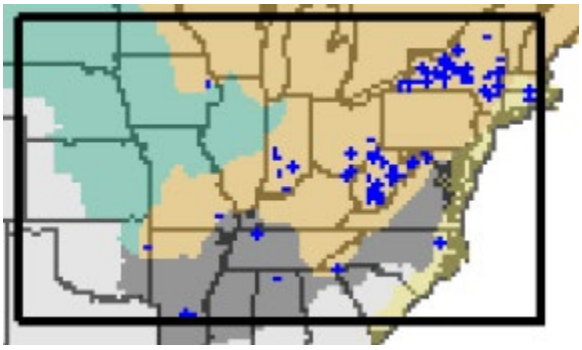
Focus on the **Median Activity** Row:

Median counts of call sequences of *Myotis septentrionalis* were predicted to decline in all but three states (Alabama, Louisiana, and Georgia). Declines in the other 33 States ranged from 31% to 100% with a mean of an 91% decline in these states from 2009-2020.

Section 3. Abundance Estimate

Although there are many threats to *M. septentrionalis*, the predominant threat by far is WNS. If this disease had not emerged, it is unlikely the northern long-eared bat would be experiencing such a dramatic population decline. WNS was the main reason for listing the species as threatened under the Federal Endangered Species Act in 2015. Since symptoms were first observed in New York in 2006, WNS has spread rapidly throughout the species' range in the United States. Numbers of northern long-eared bats, gathered from hibernacula counts, have declined by 97 to 100% across the species' range.

Beginning in February of 2020, researchers and staff of the United States Geological Survey (USGS), Bat Conservation International (BCI), Virginia Polytechnic Institute and State University, and Montana State University associated with the North American Bat Monitoring Program (NABat) collaborated with the United States Fish and Wildlife Service (USFWS) to provide technical assistance in support of the USFWS Three Bat Species Status Assessments (SSA) including the little brown bat (MYLU, *Myotis lucifugus*), northern long-eared bat (MYSE, *Myotis septentrionalis*), and tricolored bat (PESU, *Perimyotis subflavus*). As of June 2022, results of this SSA have not been officially released by the USFWS.



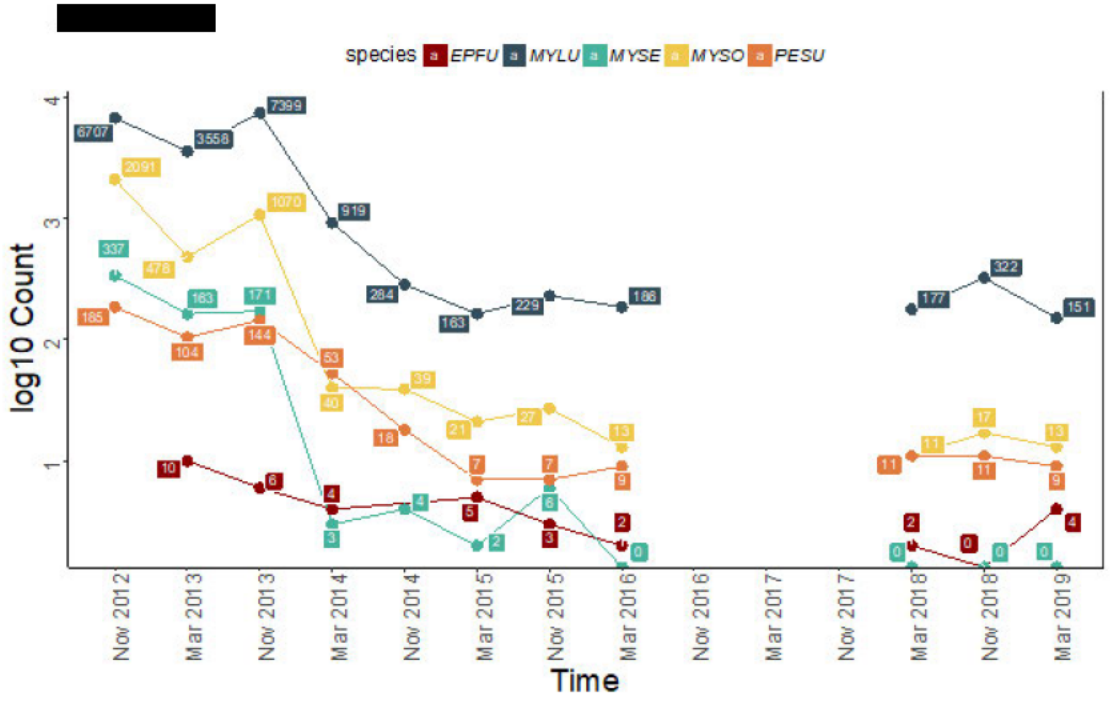
Sampling sites that recorded *Myotis septentrionalis* calls at least once from 2009-2020 (blue points).

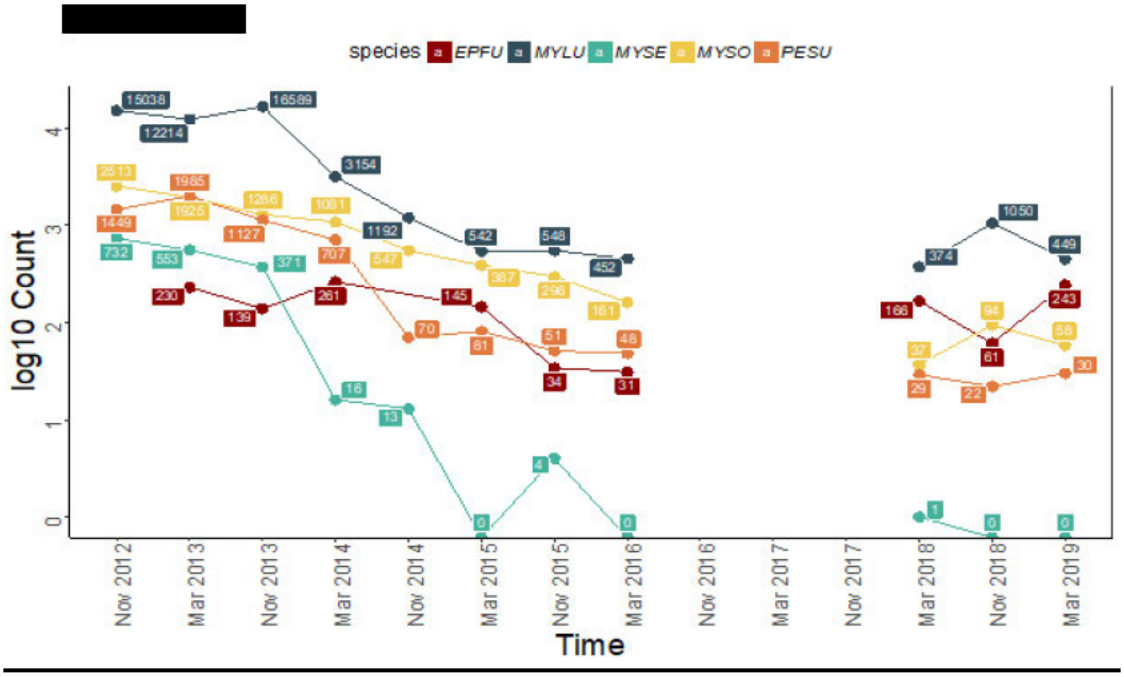
YEAR	SITE NAME	*Myotis septentrionalis*
*2022	[redacted]	140
2022		1
2022		6
2022		1
2022		0
2022		2
2022		0
2022		0
2010		21
2010		45
2022		0
**2022		1
2020		0
2015		1
2022		0
2022		0
2022		0
2022		0
2022		0
2017		0
2016		0
2016		0
2022		1

Recent northern long-eared bat winter survey results in Illinois.

YEAR	*Myotis lucifugus*	*Myotis sodalis*	*Perimyotis subflavus*	*Eptesicus fuscus*	*Myotis septentrionalis*
1999	Not Counted	9,076	NC	NC	NC
2001	NC	14,900	NC	NC	NC
2003	261	26,325	1,667	442	304
2005	136	33,176	2,320	505	640
2007	NC	43,509	NC	NC	NC
2009	730	40,705	3,695	346	326
2011	384	45,159	2,877	288	123
2018	273	69,090	1,005	45	12
2022	1,122	68,916	1,346	35	140

*Hibernating bats using [redacted]. 2005 marked the year with the highest number of hibernating *M. septentrionalis* (640) in [redacted]. Clearly, restoration and maintenance of the [redacted] is crucial not only to Indiana bats but the severely imperiled northern long-eared bat.





**Hibernating bats using [redacted] (2012-2019). 2012 marked the year with the highest number of hibernating *M. septentrionalis* (732) in [redacted]

Section 4. Population Identification and Viability

On March 22, 2022, the U.S. Fish and Wildlife Service announced a proposal to reclassify the northern long-eared bat as endangered under the Endangered Species Act. The bat, currently listed as threatened, faces extinction due to the range-wide impacts of white-nose syndrome. White-nose syndrome (WNS) has spread across nearly 80% of the species' entire range and nearly all of its U.S. range since it was listed as threatened in 2015. The proposal to change the status of the northern long-eared bat comes after an in-depth review of the species found that the bat continues to decline and now meets the definition of endangered under the ESA. The Service's review found that WNS is expected to affect 100% of the northern long-eared bat's U.S. range by 2025, spreading more quickly than anticipated across the continent. Data indicate WNS has caused estimated declines of 97 to 100% of affected northern long-eared bat populations. The proposed reclassification, if finalized, would remove the current 4(d) rule as these rules may be applied only to threatened species. A 4(d) rule is one of the many tools of the ESA for protecting species listed as threatened. Typically, the Service uses 4(d) rules to incentivize positive conservation actions and streamline the regulatory process for minor impacts. The Service will announce their final decision in November 2022.

ADDITIONAL RECOVERY OBJECTIVES THAT SHOULD BE IMPLEMENTED IN ILLINOIS [for all bats identified as a priority for recovery]:

- Additional efforts to monitor known maternity colonies and to discover additional ones on the summer landscape is needed particularly in regions hardest-hit by WNS. In some areas, aerial tracking of radio-tagged females during the spring migration is likely to be the most efficient means of locating and subsequently conserving new maternity colonies.
- Continue to pursue tried and true management approaches of fostering high reproductive success and survival, such as providing for the continual recruitment of large-diameter snags and planting/preserving/managing for live hardwoods in landscapes with a variety of well-connected forested habitat types.
- Protect hibernating bats from indiscriminate alterations to hibernacula, unauthorized human disturbance, and excessive research-related activities. The protection of hibernacula also involves conserving a buffer zone around each hibernaculum to prevent adverse impacts to the physical structure or microclimate. In general, conservation of buffer zones ensures the elimination of the negative effects of disturbances such as land clearing or development. *Protection of [redacted] is absolutely crucial to the long-term survival and future recovery of the northern long-eared bat (and Indiana bat) in Illinois.
- Effects of climate change on bats: Predictions suggest a northward expansion in the ranges of all cave-bat species, in pursuit of optimal hibernation (Humphries et al. 2002; USFWS 2007). This prediction assumes an abundance of suitable caves and other hibernaculum structures further north, but this assumption may not hold for karst-free regions at higher latitudes. Bat species may adapt by reducing torpor depth and duration during winter if prey insect species are available for more of the year (Weller et al. 2009), but bats' adaptive capacities in this regard may be limited and are not well known. Shifts in prey insect emergence may also cause mismatches with bat emergence and cause food shortages in the spring or fall.

Section 6. References

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

Caceres, M. C., R. M. Barclay. 2000. *Myotis septentrionalis*. Mammalian Species 634: 1-4.

CAIRE, W., R. K. LAVAL, M. L. LAVAL, AND R. CLAWSON. 1979. Notes on the ecology of *Myotis keenii* (Chiroptera, Vespertilionidae) in eastern Missouri. The American Midland Naturalist, 102:404-407.

FAURE, P. A., J. H. FULLARD, AND J.W. DAWSON. 1993. Attacks of the northern long-eared bat*, Myotis septentrionalis*, are relatively inaudible to moths. Journal of Experimental Biology, 178:173-189.

FENTON, M. B., H. G. MERRIAM, AND G. L. HOLROYD. 1983. Bats of Kootenay, Glacier and Mount Revelstoke national parks in Canada: identification by echolocation calls, distribution and biology. Canadian Journal of Zoology, 61:2503-2508.

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

Foster, R.W., and A. Kurta. 1999. Roosting ecology of the Northern Bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana Bat (*Myotis sodalis*). Journal of Mammalogy 80(2):659-672.

GRIFFIN, D. R. 1940. Notes on the life-histories of New England cave bats. Journal of Mammalogy, 21:181-187.

Hazard, E. B. 1982. The mammals of Minnesota. University of Minnesota Press, Minneapolis, Minnesota. 280 pp.

HITCHCOCK, H. B. 1949. Hibernation of bats in southeastern Ontario and adjacent Quebec. The Canadian Field Naturalist, 69: 47-59.

Hoffmeister, D.E. 1989. Mammals of Illinois. Urbana-Champaign: University of Illinois press.

Hofmann, J.E. 2008. Field Manual of Illinois Mammals. Illinois Natural History Survey – Champaign: University of Illinois press.

Humphries, M. M. and D. W. Thomas, and J. R. Speakman. 2002. Climate-mediated energetic constraints on the distribution of hibernating mammals. Nature 418:313-316.

JONES, C., ET AL. 1997. Revised checklist of North American mammals north of Mexico, 1997. Occasional Papers, The Museum, Texas Tech University, 173:1-19.

Kurta, A. 1995. Mammals of the Great Lakes Region. Ann Arbor: University of Michigan Press.

Lacki, M.J., D. R. Cox, L. E. Dodd, and M. B.. Dickinson. 2009 Response of Northern bats (*Myotis septentrionalis*) to Prescribed Fires in Eastern Kentucky Forests Journal of Mammalogy. 90 (5), 1165-1175.

Laubach, C. M., J. B. Bowles, and R. Laubach. 1994. A guide to the bats of Iowa. Iowa Department of Natural Resources. Des Moines, Iowa. 33 pp.

Lee, Y. F., G. F. McCracken. 2004. Flight activity and food habits of three species of Myotis bats (Chiroptera: Vespertilionidae) in sympatry. Zoological Studies 43: 589-597.

Limpens, H., K. Kapteyn. 1991. Bats, their behavior and linear landscape elements. Myotis 29: 39-48.

MANNING, R. W. 1993. Systematic and evolutionary relationships of the long-eared myotis, *Myotis evotis* (Chiroptera: Vespertilionidae). Special Publication, The Museum, Texas Tech University, 37:1-58.

MILLER, L. A., AND A. E. TREAT. 1993. Field recordings of echolocation and social signals from the gleaning bat, *Myotis septentrionalis*. Bioacoustics, 5:67-87.

MILLS, R. S. 1971. A concentration of *Myotis keenii* at caves in Ohio. Journal of Mammalogy, 52:625.

NAGORSEN, D. W, AND R. M. BRIGHAM. 1993. Bats of British Columbia: Royal British Columbia museum handbook. University of British Columbia Press, Vancouver, Canada.

Nordquist, G. E., and E.C. Birney. 1985. Distribution and status of bats in Minnesota. Final report submitted to the Nongame Wildlife Program, Minnesota Department of Natural Resources. 64 pp.+ illustrations.

Owen, S. F., M. Menzel, W. M. Ford, B. R. Chapman, K. V. Miller, J. W. Edwards, P. B. Wood. 2002. Roost tree selection by maternity colonies of northern long-eared myotis in an intensively managed forest. Gen. Tech. Rep. NE-292. Newtown Square, PA: U.S. Department of Agriculture, Forest service, Northeastern Research Station. 6 p.

Owen, S. F., M. Menzel, W. M. Ford, B. R. Chapman, K. V. Miller, J. W. Edwards, P. B. Wood. 2003. Home-range size and habitat used by the northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150:352-359.

Straw, B.R.; Martin, J.A.; Reichard, J.D.; Reichert, B.E. (editors). Analytical Assessments in Support of the U.S. Fish and Wildlife Service 3-Bat Species Status Assessment – January 2022. p. 272.

U.S. Fish and Wildlife Service (USFWS). 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 91 pp.

USGS: Communications and Publishing Database. 2021. - USGS: National Wildlife Health Center; White-Nose Syndrome Publication Portal – accessed June 2022. U.S. Geological Survey. 2016. White-nose syndrome (WNS) [web page]. National Wildlife Health Center, USGS. <www.nwhc.usgs.gov/disease_information/white-nose_syndrome/>.

VAN ZYLL DE JONG, C. G. 1979. Distribution and systematic relationships of long-eared Myotis in western Canada. Canadian Journal of Zoology, 57:987-994.

VAN ZYLL DE JONG, C. G., AND D. W. NAGORSEN. 1994. A review of the distribution and taxonomy of *Myotis keenii* and *Myotis evotis* in British Columbia and the adjacent United States. Canadian Journal of Zoology, 72:1069-1078.

Verboom, B., H. Huitema. 1997. The Importance of linear landscapes for the pipistrelle *Pipistrellus pipistrellus* and the serotine bat *Eptesicus serotinus*. Landscape Ecology 12: 117-125.

WHITAKER, J. 0., JR., AND L. 1. RISSLER. 1992. Seasonal activity of bats at Copperhead Cave. Proceedings of the Indiana Academy of Science, 101:127-135.

Whitaker, J.O., and W.J. Hamilton. 1998. Mammals of the Eastern United States. Ithaca and London: Cornell University Press.

Whitaker, John O. 2010. Mammals of Indiana: a field guide. Bloomington, Ind.: Indiana University Press. p. 112.

WDNR [Wisconsin Department of Natural Resources]. 2009. Wisconsin wildlife action plan species profile: Northern Long-eared Bat. Madison, Wisconsin, USA.

Yates, D., M. Ingalls, L. Eaton, and N. Pau. 2014. Home range analysis and roost tree selection of Northern long-eared (*Myotis septentrionalis*) and Eastern small-footed bats (*Myotis leibii*) at Great Bay NWR, NH. [Poster]. Northeastern Bat Working Group Meeting, Clinton, New Jersey.

END