Species Status Report

Little brown myotis *(Myotis lucifugus)* and Northern myotis *(Myotis septentrionalis)*

Dléa det’o̜ne (Shúhta/Shíhta Got’ı̜ne, Mountaın/K’áalo Got’ı̜ne, Délı̜ne̜ Got’ı̜ne, K’ásho Got’ı̜ne)
Daatsadh natandit’ee (Gwichyah Gwich’in)
Daatsoo natindit’ee (Teetl’it Gwich’in)
Tsáret’áné (Chıpewyan)
Gútłóolía dlų̜ą̜ det’onı (Kátł’odehche)
Vespertilion brun, Vespertilion nordique (French)

IN THE NORTHWEST TERRITORIES

DRAFT

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

TBD (2027) – Little brown myotis
TBD (2027) – Northern myotis

June 2026

Species at Risk Committee status reports are working documents used in assigning the status of species suspected of being at risk in the Northwest Territories (NWT).

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ABOUT THE SPECIES AT RISK COMMITTEE

The Species at Risk Committee was established under the *Species at Risk (NWT) Act*. It is an independent committee of experts responsible for assessing the biological status of species at risk in the NWT. The Committee uses the assessments to make recommendations on the listing of species at risk. The Committee uses objective biological criteria in its assessments and does not consider socio-economic factors. Assessments are based on species status reports that include the best available Indigenous knowledge, community knowledge, and scientific knowledge of the species. The status report is approved by the Committee before a species is assessed.

ABOUT THIS REPORT

This species status report is a comprehensive report that compiles and analyzes the best available information on the biological status of little brown myotis (*Myotis lucifugus*) and Northern myotis (*Myotis septentrionalis*) in the NWT, as well as existing and potential threats and positive influences. Full guidelines for the preparation of species status reports, including a description of the review process, may be found at www.nwtspeciesatrisk.ca.

Environment and Climate Change, Government of the Northwest Territories, provides full administrative and financial support to the Species at Risk Committee.

Cover illustration photo credits (left to right): Little brown myotis (Jesika Reimer) and northern myotis (Jesika Reimer).

Executive Summary

About the Species

Description

At least seven, possibly eight species of bats are found in the Northwest Territories (NWT): big brown bat (*Eptesicus fuscus)*, little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and likely eastern red bat (*Lasiurus borealis*). Five species were included in the NWT Species at Risk Committee's 2017 Species Status Report. This updated status report focuses on the little brown myotis and northern myotis. Both species were listed as Endangered under the federal *Species at Risk Act* (SARA) in 2014. They were also listed as species of Special Concern in the NWT under the *Species at Risk (NWT) Act* in 2018. Little brown myotis and northern myotis are hibernating species with a high vulnerability to white-nose syndrome. Increased bat monitoring throughout the NWT since the initial report in 2017 has yielded new information, increasing our understanding of these two species.

Little brown myotis and northern myotis are insectivorous bat species of the family Vespertilionidae. They are similar in size (4-13 g), can be various shades of brown, with dark brown wing membranes and ears. They can be difficult to distinguish, although northern myotis has longer ears with a longer, narrow tragus.

Biology and Behaviour

Little brown myotis and northern myotis are winter hibernators that are nocturnal during the active season. The reproductive strategy of both species is sexual reproduction with delayed internal fertilization and live birth of one young (pup) per year. Mating is indiscriminate and promiscuous and occurs primarily in swarms at hibernacula during autumn, prior to hibernation. Females are colonial breeders and become sexually mature in their first or second year. Studies suggest a mean life expectancy of 6-7 years for the little brown myotis (max. recorded 34 years); and in the NWT, mark-recapture surveys identified two female little brown myotis that were at least 14 years old, both of which were reproductive. Mean life expectancy is not reported in the literature for northern myotis, although maximum recorded age for this species is 19 years in the wild elsewhere in its range.

Place

Distribution

There are an increasing number little brown myotis and northern myotis occurrence records in the NWT identified through ultrasonic recording, guano collection at bridges and caves, capture surveys, and bat sightings. Both species appear to be widespread throughout the southern NWT. Little brown myotis is confirmed to be present throughout the South Slave and Dehcho regions, and north up the Mackenzie River to the Wrigley area. Northern myotis is confirmed to be present throughout the South Slave and Dehcho regions. Bat sightings (unknown species) are reported in the northern regions of the territory, including a confirmed bat sighting near Aklavik in 2024. Maternity colonies and hibernacula have been documented in the southern regions of the NWT including the South Slave and Dehcho.

Habitat

Both species are forest-dwelling bats that require (1) summer roost and foraging habitat, (2) autumn transitional roosts, as bats prepare for hibernation during swarming, and (3) winter hibernation sites. These species perform annual small-scale migrations between winter hibernacula and summer roosts. During the summer, reproductive female little brown myotis form maternity colonies in anthropogenic structures, such as buildings and bat boxes. It is likely that females also form maternity colonies in natural roosts, such as trees and rock crevices, as this has been documented in both Alaska and Yukon. Reproductive northern myotis form maternity colonies in large-diameter, mature deciduous trees, such as trembling aspen, that have structural features such cavities and cracks. Northern myotis requires a high density of suitable roost trees in their maternity roosting area. During autumn, both species use tree and rock roosts during swarming, and little brown myotis will also use anthropogenic structures if available close to hibernacula. Both species overwinter in hibernacula with stable temperatures and high humidity, such as caves and deep rock crevices. Important hibernacula have been identified in karst topography in the South Slave Region and NNPR, and continued exploration is needed to understand the extent of hibernacula in the NWT. Foraging habitat includes within mature forest, wetlands, open water, creeks, and along edges and linear features.

Population

Population size and trends are unknown in the NWT, as it is challenging to determine total population size and species-specific declines. The global population for little brown myotis was estimated at 6.5 million prior to the arrival of white-nose syndrome (WNS) to North America in 2007; and the populations of northern myotis prior to WNS may have been over 1 million. WNS has caused significant population declines in both species (75-100% in WNS positive areas) and in eastern Canada, there was a reported 94% decline in the number of Myotis bats after the arrival of WNS in 2010.

Threats and Limiting Factors

The most serious threat to little brown myotis and northern myotis is white-nose syndrome, as it is estimated to have killed 5.7-6.7 million bats within six years of its arrival to North America in 2007. WNS has spread rapidly and caused precipitous declines in bat populations across Canada and the United States. The fungus, *Pseudogymnoascus destructans* (*Pd*), that causes the disease, has been spreading rapidly. In 2025, *Pd* was documented in Alberta, close to the NWT border (Fort McKay) and a WNS-caused extreme mortality event was reported at an Alberta hibernaculum (Cadomin Cave, 2026) within 700 km of the NWT. During bat monitoring efforts in May 2026, white-nose syndrome was confirmed in a northern myotis near Fort Smith, at a site that is also used by little brown myotis and big brown bats (GNWT 2026). Additionally, *Pd* was detected in bat guano (feces) at Hay River (GNWT 2026; CWHC 2026; Wilson *pers. comm.* 2026). The ultimate impacts of WNS on bat populations in the NWT are uncertain. However, anticipated effects include bat mortalities at hibernation sites and declines in NWT bat populations. Both have the potential to be severe.

Changing wildfire regimes, including more frequent large, high-severity wildfires also pose a significant threat to these forest-dependent bat species, through the loss of roosting and foraging habitat. Northern myotis maternity roosts are found in mature, large-diameter trees, and it may take at least 100 years post-fire for suitable maternity roost trees to be present on the landscape. Severe drought conditions can also impact roosting and foraging habitat with significant tree mortality occurring due to drought and drought-related diseases. Low water availability due to drought negatively impacts bat prey (insect) populations, which can reduce reproductive rates in bats.

Additional threats are likely minimal, and include human impacts at hibernacula, exclusion and removal of maternity roosts (lethal or non-lethal removal of bats by building owners, or incidental removal as a result of development activities), timber harvesting, predation by house cats, the SARS-CoV-2 virus, wind power development, and contaminants (such as mercury, pesticides, and runoff from industrial activities).

Positive Influences

Public education and community involvement with bats has continued to develop, with regular presentations, meetings, consultation, and dissemination of information by GNWT-ECC and Parks Canada. Community members actively contribute observations to the GNWT-ECC occurrence database by reporting bat sightings to GNWT-ECC and on iNaturalist. Regional workshops and community meetings allow researchers and community members to share their experiences observing bats in their communities. Community events, such as the "Build a Maternity Bat Box Workshop" and the Northern Whooping Crane Festival in Fort Smith have allowed the public to gain knowledge and tools to manage bats in buildings and learn about bat monitoring and research.

Increased survey efforts in the NWT, in partnership with researchers, local communities and organizations, have resulted in new information on species distribution, increasing our understanding of range extent in the NWT.

Artificial roosts, such as bat boxes, have been used effectively in the NWT to provide alternative roost habitat for little brown myotis post-wildfire, and in encouraging bats to relocate from anthropogenic building roosts.

Monitoring for WNS, through guano collection, swabs, and testing carcasses, is ongoing in the NWT. Promising headway is being made with the development and implementation of probiotic treatments to reduce the impacts of white-nose syndrome, including trials in Washington, BC, and Alberta.

In 2013, COSEWIC assessed little brown myotis and northern myotis as Endangered species in Canada due to population declines caused by white-nose syndrome. Both species were subsequently listed as Endangered under the federal *Species at Risk Act* (SARA) in 2014. A national recovery strategy was developed and includes critical habitat identification including the protection of two known hibernacula in the NWT. In addition, two national parks have been created, resulting in the protection of more than 30,000 km^2 of land.

In 2017, the NWT Species at Risk Committee assessed little brown myotis and northern myotis as species of Special Concern in the Northwest Territories because of their high vulnerability to white-nose syndrome. In 2018, little brown myotis and northern myotis were listed as species of Special Concern in the NWT under the *Species at Risk (NWT) Act*. An NWT Bats Management Plan was developed in 2020, and a progress report is currently being developed to report on the actions taken and taken to implement the management plan and progress towards the outlined objectives.

Technical Summary

Question	Scientific Knowledge
Population Trends	
Generation time (average age of parents in the population) (indicate years, months, days, etc.).	**Little brown myotis:** 11 years (R_{span} calculation); 5-10 years (COSEWIC) **Northern myotis:** 7 years (R_{span} calculation); 5-10 years (COSEWIC)
Number of mature individuals in the NWT (or give a range of estimates).	Unknown. **Little brown myotis:** Capture surveys in the NWT yielded the handling of a total of 2,060 individual little brown myotis in the South Slave Region between 2011-2016, and 2021-2025. **Northern myotis:** Capture surveys in the NWT yielded the handling of 246 individual northern myotis in the South Slave Region between 2011-2016 and 2021-2025. Given the limited survey effort across the large geographic range, NWT populations of both species are certainly higher than the populations observed at these hibernacula, maternity colonies, and capture events.
Percent change in total number of mature individuals over the **last** 10 years or 3 generations, whichever is longer.	Unknown; there may be population impacts from large, fast-spreading, high-severity wildfires, but the impacts have not been assessed. With the arrival of WNS to the NWT in 2026, the impact to bat populations in the NWT are currently unknown.
Percent change in total number of mature individuals over the **next** 10 years or 3 generations, whichever is longer.	Unknown; likely to experience >90% population decline in areas impacted by WNS. With the arrival of WNS to the NWT in 2026, the anticipated effects will likely include bat mortalities at hibernation sites and declines in the total number of mature individuals.

Percent change in total number of mature individuals over any 10 year or 3 generation period that includes **both the past and the future**.	Unknown.
If there is a decline in the number of mature individuals, is the decline likely to continue if nothing is done?	Unknown; the ultimate impacts of WNS on bat populations in the NWT are uncertain but declines related to WNS are expected in the next ten years if nothing can be done.
If there is a decline, are the causes of the decline reversible?	Unknown; due to the slow life history traits of bats, population recovery will be slow and is not guaranteed particularly with the arrival of WNS.
If there is a decline, are the causes of decline clearly understood?	Expected declines related to WNS are generally well understood (an estimated >90% population decline); declines related to habitat loss, wildfire, climate change, and human-related impacts are more nuanced and require further investigation.
If there is a decline, have the causes of the decline been removed?	Unknown.
If there are fluctuations or declines, are they within, or outside of, natural cycles?	Unknown.
Are there 'extreme fluctuations' (>1 order of magnitude) in the number of mature individuals?	No; however, extreme fluctuations are expected with the arrival of WNS.
Distribution	

Estimated extent of occurrence in the NWT (in km²).	**Little brown myotis:** 457,019 km² (including extralimital observation in Colville Lake) **Northern myotis:** 206,797 km²
Index of area of occupancy (IAO) in the NWT (in km²; based on 2 x 2 grid).	**Little brown myotis:** 62 km² **Northern myotis:** 28 km² *both likely underestimated as relatively few maternity roosts and hibernacula have been documented in the NWT.
Number of extant locations[1] in the NWT.	White-nose syndrome (WNS) is the most serious plausible threat to bats in the NWT. Based on this threat, there are two extant locations that are defined in the NWT (South Slave hibernacula concentration and Nahanni hibernacula concentration) for both little brown myotis and northern myotis **Little brown myotis:** 2 **Northern myotis:** 2 Outside of WNS, the disturbance or loss of summer roosts and/or hibernacula due to a variety of factors is a serious threat. Using hibernacula and maternity roost areas as a minimum (many more are expected to be present in the NWT), the number of locations is at least: **Little brown myotis:** 10 **Northern myotis:** 7
Is there a **continuing decline** in area, extent, and/or quality of habitat?	Not likely
Is there a **continuing decline** in number of locations, number of	Not likely

[1] Extant location – The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a species is affected by more than one threatening event, location should be defined by considering the most serious plausible threat.

populations, extent of occupancy, and/or IAO?	
Are there 'extreme fluctuations' (>1 order of magnitude) in number of locations, extent of occupancy, and/or IAO?	No; however, extreme fluctuations are expected with the arrival of WNS.
Is the total population 'severely fragmented' (most individuals found within small and isolated populations)?	No
Immigration from Populations Elsewhere	
Does the species exist elsewhere?	Yes.
Status of the outside population(s)?	Unknown; there have been severe declines in bat populations in eastern Canada and across the United States due to WNS. Nearby populations of little brown myotis and northern myotis in Alberta and Saskatchewan are impacted by WNS, and *Pd* has been documented in British Columbia. WNS is not yet present in the Yukon, so populations are presumed to be stable there for now.
Is immigration known or possible?	Possible; however, if WNS-related population declines occur, nearby populations (e.g. Alberta, Saskatchewan) are also being impacted which will limit the amount of rescue possible.
Would immigrants be adapted to survive and reproduce in the NWT?	Yes.

Is there enough good habitat for immigrants in the NWT?	Yes; however, hibernacula in the NWT are likely contaminated with *Pd*.
Is the NWT population self-sustaining or does it depend on immigration for long-term survival?	Yes; healthy, stable maternity colonies for both little brown myotis and northern myotis have been documented, suggesting that the NWT population is self-sustaining.
Threats and Limiting Factors	
Briefly summarize negative influences and indicate the magnitude and imminence for each.	During bat monitoring efforts in May 2026, white-nose syndrome was confirmed in a northern myotis near Fort Smith, at a site that is also used by little brown myotis and big brown bats (GNWT 2026). Additionally, *Pd* was detected in bat guano (feces) at Hay River (GNWT 2026; CWHC 2026; Wilson *pers. comm.* 2026). The ultimate impacts of WNS on bat populations in the NWT are uncertain. However, anticipated effects include bat mortalities at hibernation sites and declines in NWT bat populations. Both have the potential to be severe. Climate change is causing an increasing frequency of large, high-severity wildfires – severity of impact is unknown, but loss of roosting and foraging habitat is likely significant. Drought – although there has been severe and extreme drought throughout bat habitat, the severity of this drought on bat populations, through lack of water and insect prey and possible impacts to roosting habitat, is unknown. The current impacts of additional threats, such as human impacts at hibernacula, exclusion and removal of maternity roosts, timber harvesting, predation by house cats, the SARS-CoV-2 virus, wind power, and contaminants, are considered minimal.
Positive Influences	

Briefly summarize positive influences and indicate the magnitude and imminence for each.	Increasing public education and community involvement has allowed for the dissemination of critical information and has resulted in an increased awareness and stewardship of bats and bat habitat. The expansion of acoustic and capture survey efforts have provided critical information including expanded species distribution ranges and identifying new maternity colony and hibernacula locations for little brown myotis and northern myotis. These projects build capacity for continued bat monitoring across communities in the NWT will contribute to long-term monitoring of population trends in the future. Artificial bat habitat, such as bat boxes, have been used after the destruction of an occupied roost, confirming the importance of alternate roost availability. GNWT-ECC is actively monitoring for WNS through testing guano, swabs, and carcasses. Trials outside of the NWT for experimental probiotic treatments to reduce WNS-related mortality appear to be positive and are being implemented in Alberta, which may help reduce the mortality rate in bat populations adjacent to those in the NWT. The listing of little brown myotis and northern myotis under SARA has allowed for the protection of two hibernacula. With WNS likely to arrive within 1-4 years, it is important that there is protection in place for critical habitat. An additional 30,000 km^2 of land has been protected as national parks and the Thaidene Nëné Indigenous Protected Area. Habitat protection from human disturbance may be particularly critical with WNS likely to arrive within 1-4 years. However, protected areas are still subject to large high-severity wildfires, which reduces available habitat and creates fragmentation. In 2018, little brown myotis and northern myotis were listed as species of Special Concern in the NWT under the

	Species at Risk (NWT) Act, due to their vulnerability to WNS. An NWT Bat Management Plan was developed in 2020, and a five-year progress report is in development to report on the actions taken and progress towards outlined objectives.

Glossary

Acronym	Term
AO	Area of occupancy
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWHC	Canadian Wildlife Health Cooperative
EO	Extent of occurrence
FMA	Forest Management Agreement
GNWT	Government of the Northwest Territories
GNWT-ECC	Environment and Climate Change – Government of the Northwest Territories
IAO	Index of area of occupancy
IUCN	International Union for Conservation of Nature
NNPR	Nahanni National Park Reserve
SARA	*Species at Risk Act*
SARC	Northwest Territories (NWT) Species at Risk Committee
WNS	White-nose syndrome

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PLACE NAMES

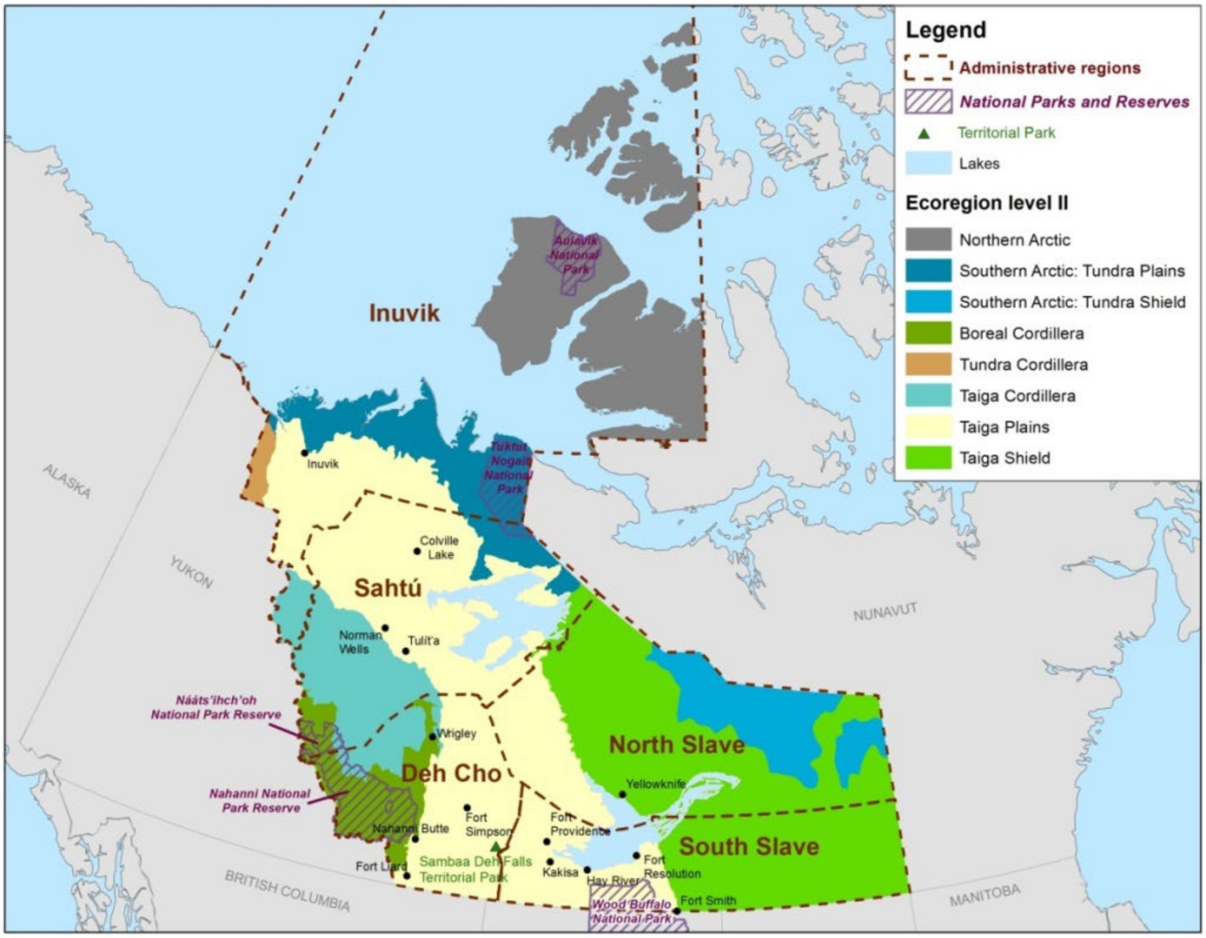

Figure 1. Map of Northwest Territories showing the regions mentioned in this report, communities, protected areas.

Preface

In the preparation of this report, an effort was made to find documented and available sources of Indigenous knowledge, community knowledge, and scientific knowledge of little brown myotis (*Myotis lucifugus*), and northern myotis (*Myotis septentrionalis*) in the NWT. At this time, little Indigenous and community knowledge of bats has been documented, and while this should not imply that no information from these sources exist, this report is, by consequence, primarily based on scientific knowledge sources.

Preamble

At least seven, possibly eight species of bats are found in the Northwest Territories (NWT): big brown bat (*Eptesicus fuscus)*, little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and likely eastern red bat (*Lasiurus borealis*). The initial NWT Species at Risk Committee's 2017 Species Status Report titled *Species Status Report for Big Brown Bat, Little Brown Myotis, Northern Myotis, Long-eared Myotis, and Long-legged Myotis (Eptesicus fuscus, Myotis lucifugus, Myotis septentrionalis, Myotis evotis, and Myotis volans) in the Northwest Territories* included five bat species, and this updated status report focuses on new information for the little brown myotis and northern myotis. Both little brown myotis and northern myotis were listed as Endangered under the federal *Species at Risk Act* (SARA) in 2014. They were also listed as species of Special Concern in the NWT under the *Species at Risk (NWT) Act* in 2018.

Little brown myotis and northern myotis are hibernating bat species with a high vulnerability to white-nose syndrome (WNS), a disease caused by the fungus *Pseudogymnoascus destructans* (*Pd*). In 2026, both *Pd* and WNS were documented in the NWT for the first time (CWHC 2026; GNWT 2026).

Since the 2017 status report was published, bat monitoring efforts throughout the NWT has yielded new information on these two species. The NWT is part of coordinated national surveillance efforts to track the spread of Pd and WNS. Surveillance efforts have included collecting and testing guano (feces), swabbing captured bats, submitting dead bats for disease testing, and encouraging the public to report unusual bat observations.

ABOUT THE SPECIES

Names and Classification

Common name (English):	**Little brown myotis**	**Northern myotis**
Scientific name:	*Myotis lucifugus* (LeConte 1831)	*Myotis septentrionalis* (Trouessart 1897) (classified as Myotis keenii prior to 1979)
Synonyms:	Little brown bat	Northern long-eared bat
French:	Vespertilion brun	Vespertilion nordique
Chipewyan – Deninu Kue and Łutsel K'e	Tsáret'áné (bat) (South Slave Divisional Education Council [SSDEC] 2012, 2014)	
South Slavey - Kátł'odeeche	Gútłóolía dlųą det'onı (bat) (SSDEC 2009)	
Shúhta/Shíhta Got'įne or Mountain and K'áalo Got'įne or Willow Lake dialects [Tulıt'a], Délįnę Got'įne, K'ásho Got'įne [Fort Good Hope and Colvılle Lake]	Dléa det'ǫne (flying squirrel) (Sahtú Renewable Resources Board [SRRB] and Species at Risk Secretariat 2013)	
Gwichyah Gwich'in	Daatsadh natandit'ee (flying mouse) (Gwich'in Language Centre and Gwich'in Social and Cultural Institute [GSCI] 2005)	
Teetl'it Gwich'in	Daatsoo natindit'ee (flying mouse) (Gwich'in Language Centre and GSCI 2005)	
Class:	Mammalia	
Order:	Chiroptera	
Family:	Verpertilionidae (Vesper bats)	
Life form:	Vertebrate, mammal, bat	

Systematic/Taxonomic Clarifications

Little brown myotis

There are five recognized subspecies of *Myotis lucifugus* including *M. l. alascensis*, *M. l. carissima*, *M. l. lucifugus, M. l. pernox*, and *M. l. relictus* (Francis *et al.* 2022). *Myotis* *occultus* was previously considered a subspecies of *M. lucifugus* (Jones *et al.* 1992) but is now considered a separate distinct species.

Northern myotis

Myotis septentrionalis was formerly considered a subspecies of *M. keenii* (van Zyll de Jong 1979). Much of the older literature using the name *M. keenii* pertains to *M. septentrionalis*. *M. septentrionalis* was first considered as a separate species by Jones *et al.* (1992) and was formally recognized as a species distinct from *M. keenii* in Wilson and Reeder (2005).

Description

A labeled anatomical drawing of a bat is included in Appendix A (Figure 19) for reference. Figure 2 shows a little brown myotis and Figure 3 shows a northern myotis.

Echolocation call characteristics have been described for both species, however there is much overlap in call shape and frequency between the two species (Fenton and Barclay 1980; Caceres and Barclay 2000; Lausen *et al.* 2022).

Figure 2. Little brown myotis (*Myotis lucifugus*), Salt River, NWT. Photo credit: Jesika Reimer.

Figure 3. Northern myotis (*Myotis septentrionalis*), Fort Liard, NWT. Photo credit: Jesika Reimer.

Little brown myotis

Little brown myotis are various shades of brown in fur colour, with wing membranes and short ears of dark brown (Figure 2). Average total length and forearm length are 86 mm and 36.5 mm, respectively and average mass is 6.7 g (range: 4.2 to 12.8 g; Lausen *et al.* 2022). Little brown myotis are slightly larger (Laursen 2025) and have longer ears (Lausen *et al.* 2022) at northern latitudes compared to those at more southern latitudes. In the NWT, females are larger than males in both forearm length and body mass (Reimer and Barclay 2024). NWT captures (n = 801) report a mean (± SD) forearm length of 39.2 mm

(± 1.2) in females and 38.3 mm (± 1.3) in males (Reimer and Barclay 2024). Body mass (n = 629) is 9.1 g (± 1.1) in adult females and 8.9 g (± 1.5) in adult males (Reimer and Barclay 2024). The little brown myotis has a relatively short, blunt tragus (a small flap of cartilage in the external ear; average length = 7 mm) and ears that do not extend past its nose when pushed forward (average length = 13 mm; Adams 2003). Its calcar (cartilage frame for the tail membrane) does not have a keel (flap of skin extending beyond the calcar). The little brown myotis is distinguishable from the northern myotis by its shorter ears and shorter, blunt tragus.

Northern myotis

Northern myotis are various shades of brown in fur colour, with wing membranes and long ears of dark brown (Figure 3). Average total length and forearm length are 87 mm and 36.3 mm, respectively and average mass is 6.3 g (range: 5.2 to 7.5 g; Lausen *et al.* 2022). NWT captures (n = 123) report a mean (±SD) forearm length of 37.3 mm (± 1.1) in females and 36.6 mm (± 1.4) in males (ECC unpubl. data 2025). Body mass (n = 115) is 7.9 g (± 1.0) in adult females and 6.9 g (±0.6) in adult males (ECC unpubl. data 2025). The northern myotis has a long, narrow, pointed tragus (average length = 9 mm), and ears that extend past the nose when pushed forward (range from 14-19 mm; Caceres and Barclay 2000; Adams 2003; Lausen *et al.* 2022). Its calcar (cartilage frame for the tail membrane) does not have a keel (flap of skin extending beyond the calcar). It is distinguishable from the little brown myotis by its relatively long ears and long, narrow tragus.

Life Cycle and Reproduction

Life Cycle

Both little brown myotis and northern myotis have life cycle stages that include pre-fledged pup, pre-weaned fledgling[2], weaned fledgling, and reproductive adult. The duration of each reproductive phase (gestation, fledgling, and lactation) is determined by the extent of daily torpor use during pregnancy (increased torpor results in slower fetal development and longer pregnancy, as well as delayed and lower milk production in lactating females). The extent of daily torpor use is related to roost temperature, forage availability, and other environmental factors such as precipitation (Wojciechowski *et al.* 2007; Dzal and Brigham 2012; Kaupas 2016; Besler and Broders 2018; Geluso *et al.* 2019; Schorr and Siemers 2021).

Individuals become sexually mature their first or second year (2-20 months for

[2] A fledgling is a juvenile bat that can fly.

Vespertilionidae species; Barclay and Harder 2003). Females may be reproductively successful after their first winter (as yearlings) if they are born early in the season and achieve adequate body condition for reproduction (Frick *et al.* 2010b; Reimer and Barclay 2024), allowing multiple generations to overlap. Females may reproduce up to once per year; however, reproductive success is heavily influenced by regional weather patterns and females may forego reproduction in a year of poor resource abundance (Grindal *et al.* 1992; Frick *et al.* 2010b). Previous studies suggest that males may not become sexually mature until their second autumn swarming (Thomas *et al.* 1979); however, young of the year have been observed with sperm in the testes in Alaska suggesting that sexual maturity can be achieved during their first year (Reimer, unpublished data 2025).

Energetic expenses for females increase throughout the reproductive cycle, with the greatest demands associated with lactation. With higher energetic demands, foraging duration and prey consumption increases (Belwood and Fenton 1976; Kurta *et al.* 1989; Brigham 1991; Reimer 2013). During hibernation, individuals rely on fat stores accumulated during summer and autumn to meet energetic expenses (Thomas *et al.* 1990).

Globally, the average lifespan for bat species in the family Vespertilionidae (composed of 354 species) is approximately 15 years (Barclay and Harder 2003). Mark-recapture studies have reported a maximum documented lifespan for a banded little brown myotis of 34 years (Davis and Hitchcock 1965; Keen and Hitchcock 1980); and for a banded northern myotis of 19 years (Kurta 1995 in Wilkinson and South 2002). Due to high mortality rates for juveniles (23-46%; Frick *et al.* 2010a), a mean life expectancy of 6 to 7 years is reported for little brown myotis (Keen and Hitchcock 1980); mean life expectancy is not reported in the literature for northern myotis. In the NWT, a mark-recapture study in the South Slave region from 2011 to 2025 reported recapturing two bats 13 years after first marking. These females were mature adults at the time of first capture, suggesting that they are at least 14 years or older; and both individuals were reproductive when recaptured 13 years after banding.

Generation time (the average age of parents to young of the year) gives insight into the turnover rate of breeding individuals in the population. Since there is insufficient data to populate a life history table, generation time was calculated using the R*span* method (see Appendix A). Generation time was calculated as 11 years for little brown myotis. This is consistent with calculations reported by the IUCN: 5-10 years (Solari 2021) and COSEWIC 3-10 years (COSEWIC 2013). Generation time was calculated as 7 years for northern myotis. This is consistent with calculations reported by the IUCN: 6 years (Solari 2018) and COSEWIC: 3-10 years (COSEWIC 2013).

Reproduction

The reproductive strategy of both little brown myotis and northern myotis is sexual reproduction with internal fertilization and live birth. Mating is indiscriminate and promiscuous and occurs primarily during swarming behaviour at hibernacula during autumn, prior to hibernation (Thomas *et al.* 1979; Burns and Broders 2015). Females store sperm over winter and fertilize a single egg during spring ovulation when they leave hibernation (O'Farrell and Studier 1973; Fenton and Barclay 1980; Caceres and Barclay 2000). Females produce a single offspring (called a pup). Little brown myotis and northern myotis are both colonial breeders (see Habitat Requirements). At birth, Vespertilionidae bats average 23.0% ± 8.0% of adult female mass (range 11.1-35%) and at first flight they average 75.0 ± 21.0% of adult female mass (Barclay and Harder 2003). Pups feed exclusively on milk until they fledge (Kurta *et al.* 1989), and weaning occurs on average 40.9 days (SE = 36) after birth (Barclay and Harder 2003).

Little Brown Myotis

Gestation lasts for approximately 50 to 60 days (O'Farrell and Studier 1973), and parturition is asynchronous with a wide range of parturition dates (e.g. 42 days; Krochmal and Sparks 2007). In the NWT, parturition occurs from late June to early July (Reimer and Barclay 2024). Twinning can occur, but it is rare (Currie *et al.* 1988; Nagorsen and Brigham 1993). Mass at birth for little brown myotis is approximately 20-30% of adult female weight (Burnett and Kunz 1982).

The proportion of adult females in reproductive condition at little brown myotis colonies in the South Slave region have been reported as 49-79% (two maternity colonies monitored for three years, 526 adult females assessed; Reimer 2013; Reimer and Kaupas 2013) and 79-81% (Thebacha maternity colony monitored for two years; Kaupas and Barclay 2015). Reimer and Barclay (2024) found, over a two-year period, that reproductive success varied by individual and by year. The majority (68%) of recaptured females (21 of 31) reproduced both years, while 26% reproduced only one of the two years (8 of 31) and 6% were not reproductive in either year (2 of 31). One juvenile bat that was banded as a post-fledged pup, was recaptured the following summer and shown to be reproductive as a yearling. This rate is lower than those observed in more southerly locations (e.g., New Hampshire – 87-99%, Frick *et al.* 2010a; eastern U.S. – >96%, Cagle and Cockram 1943, Humphrey and Cope 1976) but higher than proportions observed in the Yukon (33-74%; Talerico 2008) and suggests that at least a portion of the population is healthy enough to reproduce annually (described in Reimer 2013). In general, reproduction in little brown myotis has been shown to decline with increasing latitude (Barclay *et al.* 2004). Sixty-eight percent of banded female recaptures in the South Slave region were reproductive for two consecutive years, suggesting that over half of the sampled population had a high enough body condition to support both reproduction and preparation for hibernation in consecutive years (Reimer and Barclay 2024).

Northern Myotis

By comparison, parturition for northern myotis is relatively synchronous (e.g. within a 6-day period; Krochmal and Sparks 2007) and is reported in the NWT from early to mid July (approximately July 5 to 10; Kaupas and Barclay 2015). Northern myotis are born significantly smaller than little brown myotis (Krochmal and Sparks 2007).

In the NWT, reproductive proportions for northern myotis captured during 2014 and 2015 at maternity colonies were 80% (n = 5) and 66% (n = 18) respectively (Kaupas 2015; Kaupas and Barclay 2015), which is somewhat lower than observations at maternity sites farther south (e.g., 80%, West Virginia; Francl *et al.* 2012 and 97%, Illinois; Feldhamer *et al.* 2001).

NWT Population Structure

Reported captures of little brown myotis and northern myotis in the NWT are both female-biased at maternity colonies and male-biased at hibernacula and foraging sites, which is similar to elsewhere in their range (Agosta *et al.* 2005). In the NWT, juvenile captures, which provide a better measure of sex ratio[3], indicate a slight female bias for little brown myotis (53%; 163 of 309 individuals were female; 2011-2018) and a male bias in captures for northern myotis (57%; 20 of 35 individuals were male from 2011-2015; GNWT-ECC unpubl. data). These distributions are similar to a juvenile sex ratio of 1:1 for little brown myotis and northern myotis at more southerly locations (Central Appalachians; Agosta *et al.* 2005).

In the South Slave region, populations of little brown and northern myotis are composed of primarily middle-aged individuals (Table 1). This age structure is consistent across capture sites and species, as well as with observations for little brown and northern myotis at more southerly locations (Agosta *et al.* 2005).

[3] Capture rates may be affected by the site, habitat, age, sex, and/or reproductive status of the bats, therefore capture rates are a potentially biased measure of the overall sex ratio in the population. The capture rate for male juvenile versus female juvenile bats should be more representative of the population sex ratio.

Table 1. Age class structure of little brown and northern myotis in the South Slave region of the NWT, measured over seven years (2011-2016, 2018; Reimer and Barclay 2024; GNWT-ECC unpubl. data 2025). Age classes are determined by tooth wear; see Holroyd 1993 for details).

	Little brown myotis			**Northern myotis**		
Age class	**Maternity colony**	**Hibernacula**	**Forage site**	**Maternity colony**	**Hibernacula**	**Forage site**
Juvenile	23%	0%	16%	11%	0%	17%
Young (tooth wear 1-2)	8%	3%	5%	11%	0%	5%
Mid-age (tooth wear 3-5)	68%	94%	72%	76%	92%	74%
Old (tooth wear 6-7)	1%	3%	7%	2%	8%	4%
Sample size	*1,155*	*111*	*276*	*46*	*12*	*180*

Physiology and Adaptability

Little brown myotis and northern myotis both use daily torpor[4] and seasonal hibernation to conserve energy during periods of low prey abundance (e.g., winter) and/or increased energetic expense (e.g., cooler temperatures). This behaviour allows them to survive extreme and/or unfavourable conditions (Thomas *et al.* 1990; Dzal and Brigham 2012; Besler and Broders 2019).

During winter hibernation, bats adjust their energy use by selecting different microclimates within the roost and by altering the depth and duration of torpor bouts. Bats with lower fat reserves may select cooler microclimates which allow for increased energy savings (Boyles *et al.* 2007). During hibernation, females use their fat reserves more slowly than males by reducing the duration of their arousals, likely a strategy to have adequate fat stores upon spring emergence to initiate reproduction (Czenze *et al.* 2017).

During summer, bats require adequate food and water to support both summer reproduction and winter survival. Summer temperature tolerance varies by species. In more southerly locations, some species do not leave their roosts when ambient temperature is below 10ºC (Brigham 1991) due to the lack of aerial insects (prey); however, in the north, cooler temperatures such as 5-6ºC has been suggested as a possible threshold for roost emergence (Rydell 1991; Talerico 2008; Reimer 2013; Snively

[4] Torpor is a state of lowered activity, metabolism, heart rate, respiration, and body temperature, and is used by individuals to conserve energy.

et al. 2021). In Wood Buffalo National Park, Alberta, nighttime activity was strongly positively correlated with temperature (Reimer *et al.* 2014).

At northern sites (NWT, Alberta, Yukon and Alaska), the active period (spring emergence from hibernacula to autumn return) has been documented to range between April/May to September/October (Reimer and Barclay 2024; Wilson 2016). Despite cooler spring and autumn temperatures, these dates are comparable to the active seasons of populations further south (e.g., Norquay and Willis 2014; Meyer *et al.* 2016; Reimer and Barclay 2024). Reimer and Barclay (2024) found that reproductive activities of little brown myotis were delayed compared to southern sites, perhaps as the result of low prey availability due to cooler temperatures at the time of emergence, increased torpor use by pregnant females, or delayed parturition (birth) to invest resources in fetal development or align lactation with the longer nights post-summer solstice.

Foraging behaviour for both little brown myotis and northern myotis is nocturnal and this tends to remain true even in regions where summer nights are short (Speakman *et al.* 2000; Talerico 2008; Reimer 2013; Snively *et al.*2021). This, combined with shorter summers and cool nighttime temperatures, may limit foraging opportunities and therefore resources available for growth, reproduction and accumulation of winter fat reserves, perhaps creating an effective northern limit to the distribution of bats.

Little Brown Myotis

The little brown myotis has a broad continental range and has proven to be adaptable in various habitats and environments. In the NWT, the little brown myotis has exhibited adaptability in its foraging behaviour and habitat use, selecting for spiders (an atypical prey type) during periods of cool weather (Kaupas and Barclay 2018) or in the absence of interspecies competition (Shively *et al.* 2019; Boyles *et al.* 2016) and using the forest interior for foraging (Talerico 2008). Alterations in diet and foraging styles have also been observed in the Yukon (Talerico 2008) and Alaska (Boyles *et al.* 2016; Shively *et al.* 2019). These types of adaptations counter the inhibiting effect of lower temperatures on the availability of flying insects (Taylor 1963).

Northern myotis

Northern myotis are a gleaning species that regularly consume spiders and may not be subject to the same temperature restrictions as the little brown myotis (Kaupas and Barclay 2018).

Interactions

Interactions with Prey

Both little brown myotis and northern myotis are insectivorous and rely on adequate insect presence and abundance to support summer reproduction and winter survival (Speakman and Rowland 1999; Barclay *et al.* 2004).

Insectivorous bats employ two foraging strategies: 1) aerial hawking, whereby bats capture flying insects in the air and 2) gleaning, whereby bats catch insects off foliage or other surfaces. Little brown myotis and northern myotis both have flexible foraging behaviour and can use both methods, although northern myotis are more specialized for gleaning than little brown myotis (Ratcliffe and Dawson 2003; Kaupas and Barclay 2018). Using both aerial hawking and gleaning increases a bat's ability to diversify its diet and capitalize on available prey items throughout the season.

Food availability determines the timing of parturition, survivability of young, and ultimately, reproductive success (Arlettaz *et al.* 2001; Frick *et al.* 2010a). Species with a diverse foraging strategy and diet (e.g., little brown myotis) may be able to respond to environmental and anthropogenic changes better than those with more specialized foraging capabilities.

Little Brown Myotis

Little brown myotis feeds on a wide range of insect types, typically 4-9 mm in size (Buchler 1976; Fenton and Barclay 1980) and has been reported to consume spiders at the northern limits of its range (Talerico 2008; Kaupas and Barclay 2018; Boyles *et al.* 2016; Shively *et al.* 2018). In the NWT, little brown myotis consumes spiders during periods of low temperatures when there is lower availability of flying insects (Kaupas and Barclay 2018).

Northern Myotis

Northern myotis feed primarily on moths, beetles, caddisflies, true flies, and non-flying prey items such as spiders and moth larvae (Brack and Whitaker 2001; Kaupas and Barclay 2018).

Interactions with predators

Natural predators of bats include owls, raptors, small carnivores, rodents, and snakes (Rysgaard 1942; Fenton and Barclay 1980; Jung *et al.* 2011; Blejwas and Kohan pers. comm. *in* SARC 2017). Common house cats also prey on bats (Rysgaard 1942; O'Shea *et al.* 2011; Ancillotto *et al.* 2013; Khayat *et al.* 2020) and are considered to be a threat to bats worldwide (Oedin *et al.* 2021). Numerous cat-related bat fatalities have been reported in the NWT; in some cases samples have been submitted to ECC in Fort Smith (Kelly pers. comm. *in* SARC 2017), but these incidences are not tracked formally and cannot be quantified. Mortality and severe wing damage due to cats has been reported in Yukon (Jung *in* Environment Canada 2015) and Alaska (J. Reimer pers. comm. 2025).

Parasites and disease

Bats host numerous external and internal parasites (Rysgaard 1942; Warner and Czaplewski 1984), including various species of the bat flea (genus *Myodopsylla*), the wing mite (genus *Spinturnix*), the bat bug (genus *Cimex*), and the soft tick (*Carios kelleyi*) (Dick *et al.* 2003; Lausen 2005; Pearce and O'Shea 2007; Czenze and Broders 2011). Little brown myotis and northern myotis in particular, host ectoparasite communities that are dominated by the wing mite, *Pinturnix americanus*, and the flea, *Myodopsylla insignis*, with the wing mite being more common on northern myotis and the flea being more prevalent on little brown myotis (Sauk and Broders 2025). Ectoparasites are thought to be more abundant in urban spaces due to increased host population density (Warburton *et al.* 2023). Ectoparasites have frequently been reported for both the little brown myotis and northern myotis in the NWT (between 2014-2016, parasites were present on 77% of sampled little brown myotis and 56-75% of northern myotis, although sample size was small; GNWT-ECC unpubl. data); however, these parasites have not been identified to species and the impact these parasites have on the health of individuals has not been studied.

Rabies, caused by a virus (family Rhabdoviridae, genus *Lyssavirus*) and transmitted most often through saliva, has been reported in 13 of the bat species that live in Canada and 33 of the bats species that live in the United States (Constantine 2009). It persists at low levels in bat populations (Nadine-Davis *et al.* 2001) and follows a seasonal cycle in areas with hibernating bats, whereby rabies incidences increase during the active season and are reduced during the hibernation period. In large colonial species (e.g. Brazilian free-tailed bats, *Tadarida brasiliensis*), pups are thought to receive passive immunity through antibodies obtained from their mother's placenta and milk. During this period of passive immunity, exposure to the rabies virus results in the development of additional long-lasting antibodies which allow for active immunity throughout their life (described in Constatine 2009). The prevalence rate of rabies in healthy populations has been documented as 1% or lower (Girard *et al.* 1965; Klug *et al.* 2011) and to date, no bats have tested positive for rabies in the NWT (17 little brown myotis and one northern myotis have been tested throughout the NWT; Jutha pers. comm. 2025).

White-nose syndrome (WNS) is considered the most devastating disease for many cave-hibernating bat species in North America (Hoyt *et al.* 2021) and is discussed in Threats and limiting factors – White-nose syndrome – Disease).

Within species interactions

As discussed in *Life Cycle and Reproduction* and *Habitat Requirements*, both little brown myotis and northern myotis are colonial species that form maternity colonies of varying sizes (up to 389 bats in the NWT; GNWT-ECC unpubl. data 2025) and overwinter in large numbers (over 2900 in the NWT; Cox pers. comm. *in* SARC 2017) during hibernation. These congregations allow for protection from predators (dilution effect; Fenton *et al.* 1994), reduce individual energetic expense due to increased collective body heat (Kunz and Lumsden 2003), and facilitate information transfer, gene flow, and social interaction (Jung *et al.* 2014).

Contact among individuals at maternity colonies and hibernacula, as well as autumn swarming behaviour, may facilitate the transmission of disease among bats. Disease transmission through bat-to-bat contact (at roost/hibernation sites or during swarming) (Lorch *et al.* 2011; Langwig *et al.* 2012; Fenton pers. comm. *in* COSEWIC 2013) and substrate contact (Lindner *et al.* 2011; Puechmaille *et al.* 2011; Chaturvedi *et al.* 2012; Kilpatrick 2013) have both been documented.

In this context, bat species that exhibit clustering behaviour in hibernacula to conserve body heat (e.g., little brown myotis), may be at higher risk for bat-to-bat disease transmission than species that roost alone (Lorch *et al.* 2011; Langwig *et al.* 2012). Substrate contact cannot be discounted as an important pathway to disease transmission however; for example, the tri-coloured bat has suffered high mortality rates from WNS despite individual hibernation behaviour (COSEWIC 2013).

Multi-species interactions

Little brown myotis and northern myotis are both known to share multi-species winter hibernacula throughout their range (Rysgaard 1942; Schowalter 1980) and in the NWT, this behaviour has been observed for little brown myotis, northern myotis and big brown bats (*Eptesicus fuscus)* at the SSR-1 hibernaculum in the South Slave Region (Cox pers. comm. *in* SARC 2017; Reimer and Barclay 2024). Multiple species were also detected through DNA analysis of guano in the two hibernacula in Nahanni National Park Reserve (NNPR; Murchison pers. comm. 2025). No multi-species shared maternity roosts have been located in the NWT (Wilson *et al.* 2014); however, DNA analysis of guano found under bridges has revealed up to four bat species, including little brown myotis and northern myotis, using the same bridge, possibly for night-roosting (WCS Canada 2025a). As discussed above (Interactions – within species interactions), the use of hibernacula may facilitate disease transmission through bat-to-bat and substrate contact. At multi-species hibernacula, disease transmission between species is possible.

Territorial behaviours such as aggressiveness or protectiveness have not been documented in these bat species within their known ranges (e.g., Fenton and Barclay 1980).

Interactions with humans

Bats are not harvested in the NWT; however, it is common across North America for many home/cabin owners to dislike bats roosting in their buildings and desire to remove them. This may result in the non-lethal exclusion of bats from their roosts and/or the lethal extermination of breeding colonies (Fenton and Barclay 1980). While the prevalence of this behaviour in the NWT is currently undocumented, extermination of individual bats is known to occur (Allaire pers. comm. *in* SARC 2017; Kelly pers. comm. *in* SARC 2017). Public education efforts, such as the "Bats in Buildings" handbook and outreach initiated by the GNWT in 2019, are working to reduce the number of these incidences (Wilson, pers comm 2025). Little brown myotis and northern myotis are both insectivorous species that are important predators of insects in the NWT. See Positive influences for more information on public education efforts and the construction of artificial maternity roosts.

The Bats and Bridges project (WCS Canada 2025a) has confirmed that bats roost under bridges throughout the southern NWT. Whether bats use bridges as night roosts, day roosts for males/non-reproductive females, and/or maternity colonies is unknown. Humans may interact with bats in bridges during bridge maintenance and construction, and therefore the presence of bats should be considered when planning and implementing bridge work.

In the extreme wildfire season of 2023, there were increased reports of bats present in communities. Community members reported bats clustering on buildings and in doorways. It is possible that community buildings acted as refugia during large-scale, fast moving, severe wildfires, and that during future severe wildfire events there may be increased sightings and human-bat interaction.

PLACE

Distribution

The continental range map for little brown myotis was updated by the IUCN in 2021 with input from experts to help delineate the northern range limit. The continental range map for northern myotis was developed by GNWT-ECC (2025) based on occurrence records to better inform the northern range limit of the species. Range maps for each species in the NWT were developed using a variety of occurrence records including captures, photos, acoustic recordings, sightings, and museum specimens, in conjunction with watershed and ecoregion boundaries to inform suspected range delineations. Since *Myotis* species have similar physical characteristics and can have overlapping echolocation call characteristics, there is some uncertainty associated with photos, acoustic recordings, and sighting records compared to the more reliable capture and museum records.

World, Continental, or Canadian Distribution

Little brown myotis

The little brown myotis is the most widespread bat in North America and ranges east to west from Newfoundland and Labrador to Alaska at its northern limits, and from Florida to California at its southern limits (Figure 4; Solari 2021). Distribution in Canada includes all provinces and territories except Nunavut[5]. Distribution in the U.S. includes all continental states except Arizona, Texas, and Louisiana (NatureServe 2025).

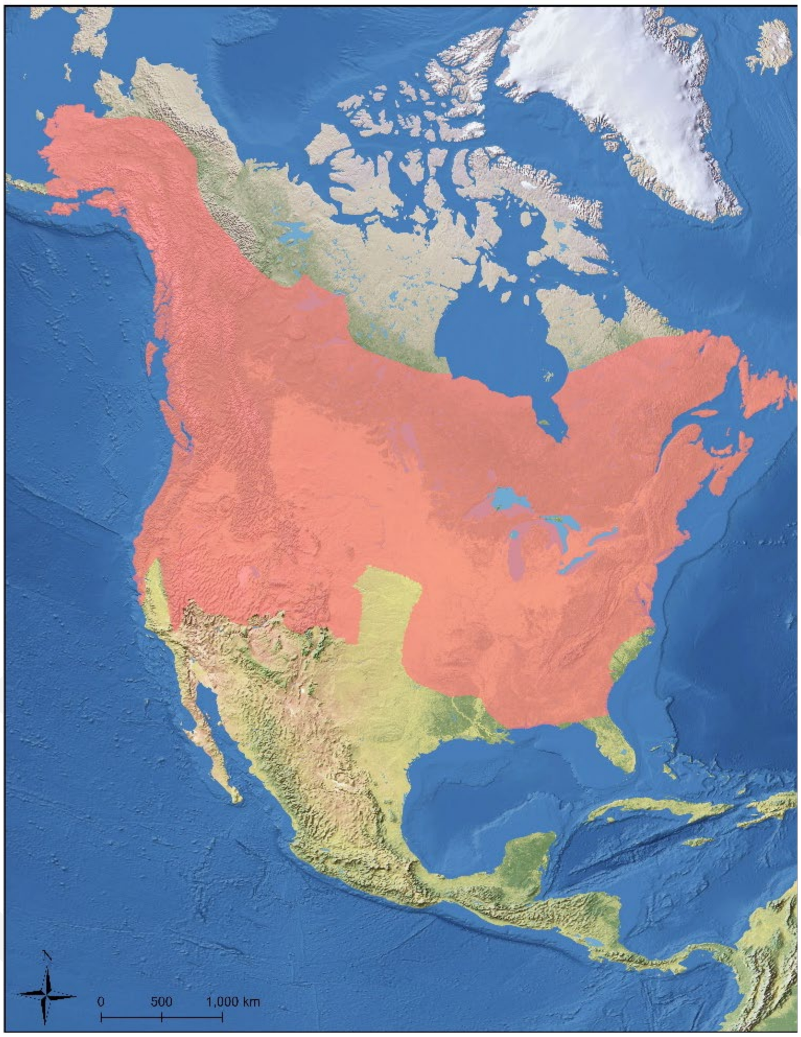

Figure 4. Continental range for the little brown myotis (*Myotis lucifugus*). Source: IUCN (International Union for Conservation of Nature) 2021.

[5] Little brown myotis is suspected, but not confirmed in Nunavut (Wilson *et al.* 2014).

Northern myotis

The northern myotis is present across Canada and the central and eastern U.S. (Figure 5; Solari 2018). Distribution in Canada includes all provinces and territories with the exception of Nunavut (described *in* NatureServe 2025); however, significant declines in eastern Canada have occurred since the arrival of WNS in 2010 (Balzar *et al.* 2021; Hooten *et al.* 2023).

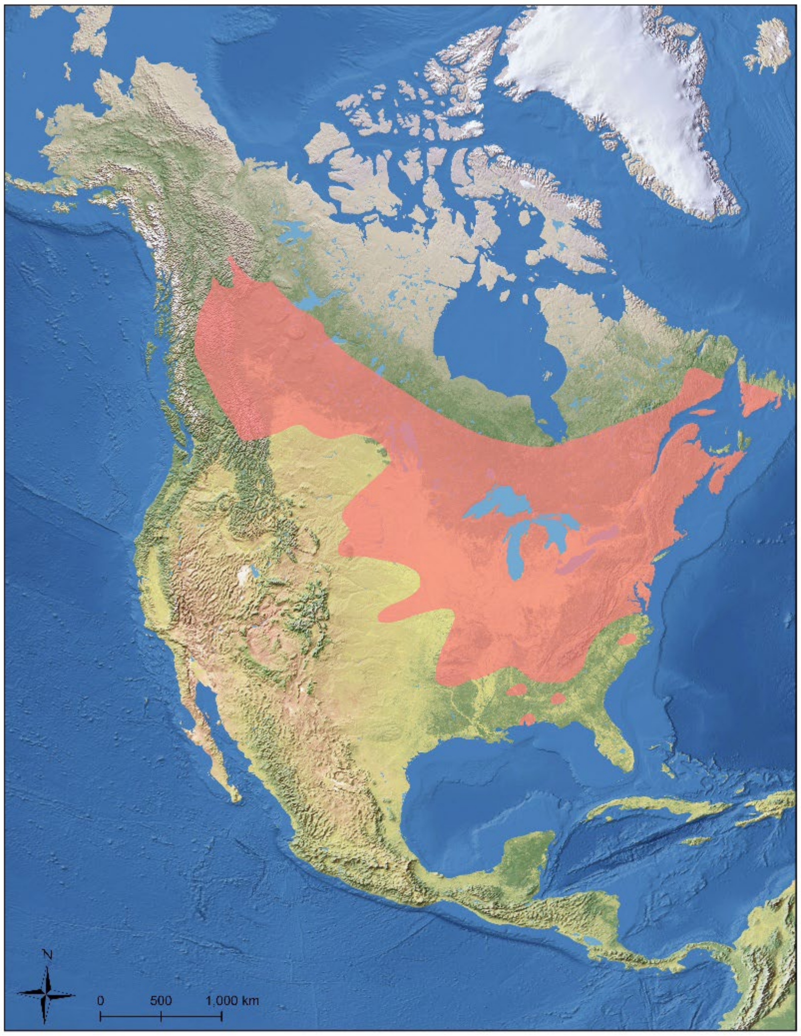

Figure 5. Continental range for the northern myotis (*Myotis septentrionalis*). Source: GNWT-ECC NWT Species at Risk Data.

NWT Distribution

The NWT mainland is composed of seven level II ecological regions (ecoregions): Southern Arctic – Tundra Plains, Southern Arctic – Tundra Shield, Tundra Cordillera, Boreal Cordillera, Taiga Cordillera, Taiga Plains, and Taiga Shield (Figure 1; Ecosystem Classification Group 2007 [rev. 2009], 2008, 2010, and 2012). These ecoregions are defined by their climatic, physiographic, and vegetative characteristics and are as such, relevant to discussions on habitat and distribution. The southern boundary of the Southern Arctic (Tundra Plains and Shield) ecoregion approximates the tree line (Ecosystem Classification Group 2012). During summer, bats have been observed in three of these regions: Boreal Cordillera, Taiga Plains, and Taiga Shield, with all observations occurring below the treeline (described *in* Wilson *et al.* 2014; GNWT-ECC unpublished acoustic data). The known winter distribution is concentrated at hibernation sites in the South Slave Region (three near Fort Smith including two in the NWT and one in AB) and Nahanni National Park Reserve (NNPR) in the Taiga Plains (one known hibernaculum; Figure 6). Additional hibernacula likely exist elsewhere in the territory.

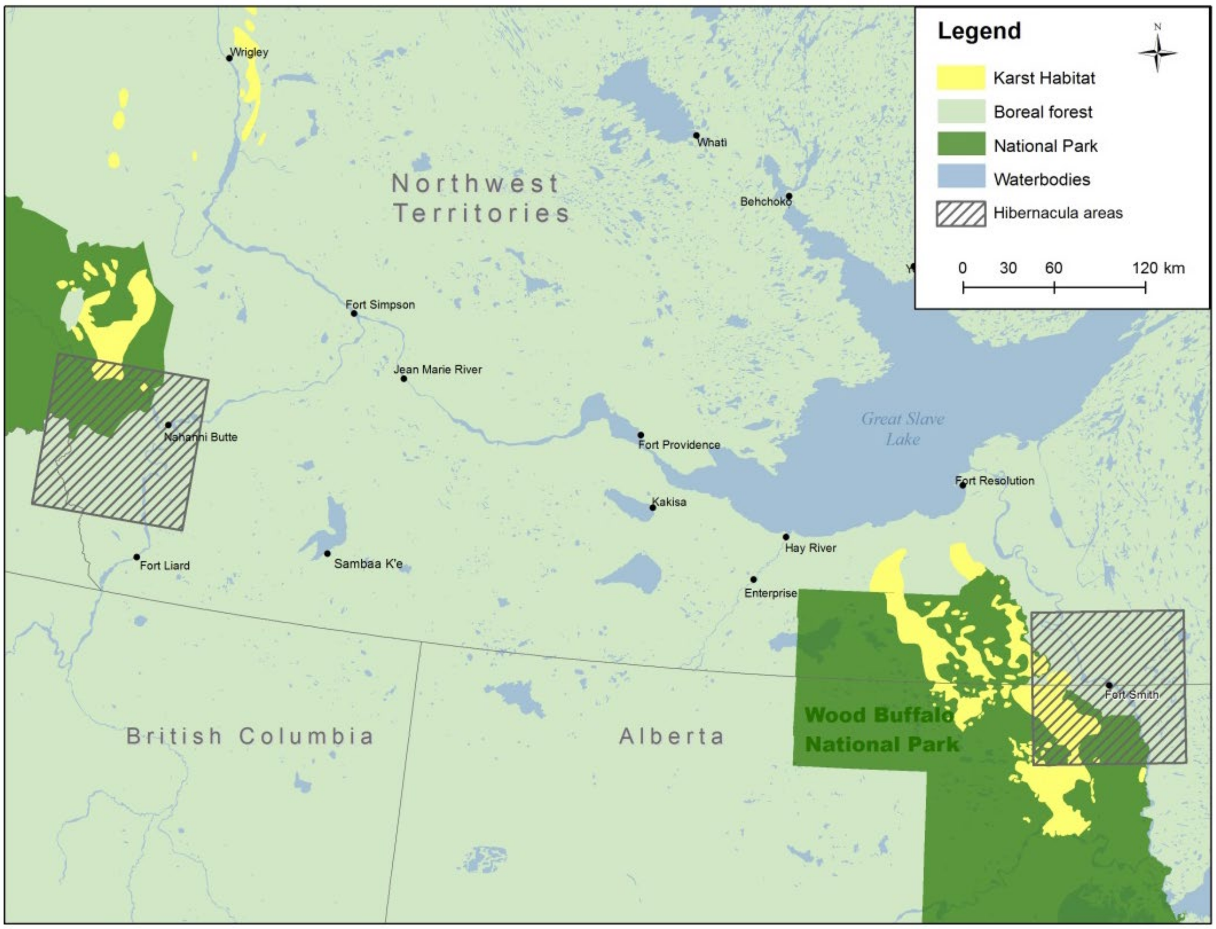

Figure 6. General areas containing known bat hibernacula in the South Slave and Nahanni regions, NWT. Specific locations of hibernacula are deemed sensitive information; contact A. Kelly, ECC or C. Murchison, Parks Canada for Further information. The karst terrain shape files were provided by the NWT Protected Areas Strategy and Wood Buffalo National Park.

Little brown myotis

The little brown myotis is the most widespread and abundant bat species in the NWT and has been observed in the Boreal Cordillera, Taiga Plains, and Taiga Shield (Figure 7 and 10). More specific areas include the Nahanni area, the Mackenzie River Valley, the South Slave region, the East Arm, and north of Great Slave Lake. The most northern confirmed observation includes a single specimen found in 2012 in Colville Lake. It has been suggested that this observation may be extralimital (occurring far outside the known range), although there are both unconfirmed and confirmed reports of bats near Tulít'a, Norman Wells, Wrigley, and in the Gwich'in region (Aklavik, Tsiigehtchic and Fort McPherson), which, if confirmed to species, may warrant a range extension (Wilson *et al.* 2014; Cooper pers. comm. *in* SARC 2017; Sallans pers. comm. 2026). The most eastern observation includes acoustic recordings from the East Arm (Hansen 2019). There are two known hibernacula in the South Slave region: hibernacula SSR-1 and SSR-2 (Figure 6; Lausen 2011; Wilson *et al.* 2014; Cox pers. comm. *in* SARC 2017; Reimer and Barclay 2024), and two confirmed hibernacula in NNPR (Horne and Critchley 2019). Little brown myotis have also been found overwintering in Walk-in Cave in Wood Buffalo National Park, just south of the NWT border (Reimer *et al.* 2014).

Based on the limited information available, summer maternity colonies are expected to be smaller and more distributed across the region compared to hibernation sites (Wilson *et al.* 2014). Little brown myotis reproduce across the South Slave and Dehcho regions. Large maternity colonies (summer congregations of reproductive females and their young) have been identified near the communities of Fort Smith, Kakisa, Hay River, and Fort Providence, and reproductive females have been captured in Nahanni National Park Reserve (Figure 8). Elsewhere in the Dehcho and South Slave regions there are reports of other groups of bats living in buildings that are possible but unconfirmed maternity colonies (Reimer 2013; Lausen *et al.* 2014; Wilson *et al.* 2014; ECC unpubl. data 2016b; Deneron pers. comm. *in* SARC 2017). The NWT population of little brown myotis is considered continuous with populations in adjacent provinces (Wilson *et al.* 2014) and a geneflow study is currently underway to assess population structure and gene flow with surrounding regions (NWT Species at Risk 2026).

Figure 7. Approximate distribution of the little brown myotis (*Myotis lucifugus*) and locations of species records in the NWT up to December 2025. Map courtesy of J. Wilson and T. Ojo, GNWT-ECC. See Appendix A for data sources.

Figure 8. Known locations of little brown bat (*Myotis lucifugus*) maternity colonies and capture locations for reproductive females in the NWT. Map courtesy of J. Wilson and T. Ojo, GNWT-ECC. See Appendix A for data sources.

Northern myotis

In the NWT, northern myotis have been observed in the Boreal Cordillera and Taiga Plains (Figure 1 and 8). There are records from around Fort Smith and Wood Buffalo National Park, the Kakisa area, Nahanni National Park Reserve, Fort Simpson, Fort Providence, and Fort Liard (Reimer and Kaupas 2013; Lausen *et al.* 2014; Wilson *et al.* 2014; GNWT-ECC unpubl. data 2025), and acoustic recordings from the East Arm (Hansen 2019). Reproductive females have been identified in the Fort Smith, Fort Liard, and Fort

Providence areas (Reimer and Kaupas 2013; Kaupas 2016; GWT-ECC unpubl. data 2025). Maternity colonies have been identified in the Fort Smith area (Figure 9; Reimer and Kaupas 2013; Kaupas 2016). Northern myotis have not been observed during winter cave surveys in the South Slave Region; however, individuals have been captured flying in and out of the SSR-1 hibernaculum (Figure 6) during spring and autumn (Reimer unpubl. data 2013; Wilson *et al.* 2014); individuals were also captured flying out of Walk-in Cave in Wood Buffalo National Park, Alberta, in spring (Reimer *et al.* 2014). Since northern myotis roost in cracks and crevices (Griffin 1940; described *in* Caceres and Barclay 2000), it is possible they were hibernating in the cave but were not observed. Therefore, it is suspected that northern myotis are likely overwintering in the SSR-1 and SSR-2 hibernacula. Similarly, DNA analysis of guano samples collected inside bat hibernacula in NNPR did not confirm the presence of northern myotis; however, northern myotis was identified from guano at nearby caves, suggesting they may be overwintering in the area. Given the ability of northern myotis to travel between summer and winter sites (see *Movements*), and the close proximity of northern myotis directly south (Vonhof *et al.* 1997; Grindal *et al.* 2011; Reimer *et al.* 2014), it is likely that the NWT population is continuous with populations in adjacent provinces.

Figure 9. Approximate distribution of the northern myotis (*Myotis septentrionalis*) and locations of species records in the NWT up to December 2025. Map courtesy of J. Wilson and T. Ojo, GNWT-ECC. See Appendix A for data sources.

Figure 10. Known locations of northern myotis (*Myotis septentrionalis*) maternity colonies and capture locations for reproductive females in the NWT. Map courtesy of J. Wilson and T. Ojo, GNWT-ECC. See Appendix A for data sources.

Other bat observations

Additional observations (species known and unknown) have been reported outside of the documented ranges for bats in the NWT (Figure 10; Wilson *et al.* 2025). These observations include locations further east in the Taiga Shield (Łutsel K'e and Hanbury River), further north in the Mackenzie Valley (Tulı́t'a and Norman Wells areas) and the most northern observation which consists of video evidence of a bat flying around a fish camp near Aklavik in the Gwich'in region (Joanna Wilson pers. comm. 2025). These observations may represent sparse occurrences and may be extralimital to the core range of bats in the NWT; however, further surveys and confirmation of species in these areas could warrant a range extension for little brown myotis or northern myotis in the future.

Figure 11. All occurrence records for bats in the Northwest Territories using data available up to 2025. Includes all little brown myotis and northern myotis occurrences that have been identified to species (including Figure 6 to 9), other bats identified to species with varying levels of confidence as well as other occurrences where the species could not be determined. Map courtesy of J. Wilson and T. Ojo, GNWT-ECC. See Appendix A for data sources.

Given the ability of flight, bats can travel long distances between summer and winter roosts (see *Movements*). Dispersal in spring and promiscuous mating in large swarms during autumn promote genetic mixing and reduce genetic isolation (Burns *et al.* 2014). Two genetic studies have included a small subset of NWT samples in larger continental geneflow assessments (Wilder 2014; Davy 2017). These studies both suggest that that little brown myotis in Taiga Plains were genetically similar to eastern populations including southern Alberta and Saskatchewan, suggesting no evidence of isolation of bats in the South Slave region and northern Alberta (Wilder pers. comm. *in* SARC 2017). Additional genetic analysis is underway to assess the population structure and geneflow of little brown myotis across the NWT to determine the potential isolation of bats in the Nahanni area given its mountainous terrain and the genetic uniqueness of bats directly west in the Yukon (Reimer pers. comm. 2025).

Locations

SARC (2024) defines 'location' as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a species is affected by more than one threatening event, location should be defined by considering the most serious plausible threat.

White-nose syndrome (WNS) constitutes the most serious plausible threat for little brown myotis and northern myotis (see *Threats and limiting factors – White-nose syndrome - Disease*), with infection at hibernacula resulting in severe population declines or extirpation. In 2025, the *Pseudogymnoascus destructans* (*Pd*) fungus that causes WNS, was documented in Fort McKay, Alberta. In 2026, the first case of WNS and Pd were confirmed in the Fort Smith area (NWT) as part of ongoing bat monitoring (GNWT 2026). Based on the threat if WNS, two extant locations are defined in the NWT (South Slave hibernacula concentration and Nahanni hibernacula concentration) for both little brown myotis and northern myotis (COSEWIC 2013). The second most serious plausible threat remains the disturbance or destruction of hibernacula/maternity roosting areas (Figure 7 and Figure 8). Using known hibernacula/maternity roosting areas as a minimum, a minimum number of extant locations may be estimated (Lausen 2006; Lausen 2011; Reimer and Kaupas 2013; Reimer and Barclay 2024; Wilson *et al.* 2014; Cox pers. comm. *in* SARC 2017; ECC unpubl. data 2025; Kaupas 2015).

Little brown myotis

For little brown myotis, the number of locations can be estimated as 10 (seven known maternity areas and three known hibernacula areas).

Northern myotis

For northern myotis, the number of locations can be estimated as 7 (four known maternity areas and three known hibernacula areas).

However, there are expected to be more hibernacula/maternity roosting areas present in the NWT. Genetic analysis to define population structure for little brown myotis across the NWT is currently underway and will provide more accurate detail on extant locations (Reimer pers. comm. 2025).

Extent of Occurrence/Area of Occupancy

The Species at Risk Committee (SARC) defines the 'extent of occurrence' (EO) as 'the area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a species' (SARC 2024). Area of occupancy (AO) is the area within the 'extent of occurrence' that is occupied by a species, excluding cases of vagrancy. The measure reflects the fact that the extent of occurrence may contain unsuitable or unoccupied habitats. The 'index of area of occupancy' (IAO) is a measure that aims to provide an estimate of area of occupancy that is not dependent on scale. The IAO is measured as the surface area of 2 x 2 km grid cells that intersect the actual area occupied by the wildlife species (i.e., the biological area of occupancy).

With the expansion of survey effort across the territory over the past decade, the EO was calculated for each species based on occurrence records. Due to the limited survey coverage within this large geographic range, the AO was calculated as the total area of the species' distribution range polygon that lies within the EO.

The IAO was measured as the surface area of 2 km x 2 km grid cells that intersect the actual area occupied by the wildlife species (i.e., area of occupancy).

Little brown myotis

Extent of occurrence for the little brown myotis was calculated as 457,019 km^2 (including the potentially extralimital observation in Colville Lake). Area of occupancy was calculated as 223,645 km^2.

To calculate the IAO, we used known point locations for summer maternity roosts and capture sites where juvenile or reproductive females were documented during summer (June – July), indicating that a maternity roost is nearby. A 2 km x 2 km grid was generated for the NWT and selected grid cells that intersected with the known point locations. We then calculated the area of selected grid cells and included an additional 4 grid cells to represent known hibernacula (not mapped due to location security). There were 27 maternity grid cells and 4 hibernacula grid cells to yield an IAO of 62 km^2. This is likely a large underestimate as relatively few maternity roosts and hibernacula have been documented in the NWT.

Northern myotis

Extent of occurrence for the northern myotis was calculated as 206,797 km^2. Area of occupancy was calculated as 134,434 km^2.

The same method to calculate IAO was used for northern myotis (see above). There were 11 maternity grid cells plus 2 confirmed hibernacula (SSR1 and SSR2) grid cells and 1 suspected overwintering area (NNPR) grid cell to yield an IAO of 28 km^2. This is likely a large underestimate as very few maternity roosts and hibernacula have been documented in the NWT.

Search Effort

Observation types in the NWT for little brown myotis and northern myotis include museum specimens, acoustic recordings, mist-net captures, guano collection, opportunistic sightings, and photo documentation (Wilson *et al.* 2014, Wilson pers. comm. 2025). The search effort has expanded greatly in the last ten years (Table 2), with (i) continued GNWT-ECC annual monitoring of four maternity colonies using capture surveys; (ii) an increasing number of acoustic surveys through GNWT-ECC, the NWT Biodiversity Monitoring Program, community partners, the National Parks (including Nahanni National Park Reserve, Náátsʼihchʼoh National Park Reserve, and Thaidene Nëné National Park Reserve), and in relation to industry projects, such as mining; (iii) guano collection through the Bats and Bridges project; (iv) surveys for hibernacula in karst terrain in Nahanni National Park Reserve; and v) spring monitoring for white-nose syndrome (WNS).

Beginning in 2011, a wide-spread acoustic monitoring effort was initiated by a GNWT-ECC biologist (J. Wilson) to document species presence and seasonality across the territory including sites in the Dehcho, South Slave, Edéhzhíe, North Slave, Sahtú, and Beaufort Delta regions (ECC 2014c; Wilson 2014; Wilson *et al.* 2014; Wilson 2016; Wilson pers. comm. 2025). Between 2011 and 2019, over 65 sites were surveyed throughout six geographic regions in the NWT. These surveys varied from short-term species detection efforts to long-term activity monitoring sites. Through these efforts, bat presence and species diversity were identified in three of the six regions. These surveys determined that bats are present and abundant throughout the southern portion of the Northwest Territories with the greatest species diversity detected in the Dehcho region, and the greatest concentration of large colonies (hibernacula and maternity roosts) in the South Slave region. Lower levels of bat activity have been recorded throughout the North Slave region indicating that bats are present but may be less abundant in this northern area. No acoustic bat activity was recorded in the Edéhzhíe, Sahtu, or Beaufort Delta.

Since 2021, numerous community-led acoustic surveys through the NWT Biodiversity Monitoring Program have been conducted throughout the territory and have increased the search effort and geographic distribution of bat acoustic monitoring in the Northwest Territories (Table 2). Parks Canada has also contributed to increased bat acoustic monitoring in Nahanni National Park Reserve, Náátsʼihchʼoh National Park Reserve, and Thaidene Nëné National Park Reserve. Both GNWT-ECC and Nahanni National Park Reserve participate in the North American Bat Monitoring Program, which involves long-term systematic bat acoustic monitoring with standardized protocols that allow for the assessment of bat populations and trends. Bat acoustic surveys have also been conducted on a variety of industry and construction projects in the South Slave and Dehcho Regions to assess species presence and possible impacts of industrial development on bat populations.

The Bats and Bridges project (WCS Canada 2025a) involved the collection of guano from under 52 bridges across the Dehcho and South Slave Regions in 2022 and 2023. Guano was reported at 25 bridges, and bat DNA was confirmed through DNA barcoding at 17 bridges. Little brown myotis and northern myotis DNA was confirmed at 17 and 7 bridges, respectively (Olson pers. comm. 2026). The results of the Bats and Bridges project has expanded the known range for northern myotis closer to Fort Resolution. Guano samples, as well as other samples collected from bats, including swabs, are also submitted for testing for *Pseudogymnoascus destructans (Pd)*, the fungal pathogen that causes white-nose syndrome. White-nose syndrome was confirmed in a northern myotis bat near Fort Smith and Pd was detected in bat guano at Hay River (GNWT 2026).

Bat capture surveys were initiated during 2006 in NNPR (Lausen 2006), and in 2011 extensive surveying and research began in the Fort Smith and Kakisa areas (Kaupas 2016; Reimer and Barclay 2024). In 2018, GNWT-ECC expanded capture survey efforts into the Hay River, Fort Providence, and Fort Liard areas. This increased the number of documented little brown myotis maternity colonies in the region and has yielded captures of reproductive northern myotis in new locations (Fort Liard and Fort Providence) suggesting the presence of nearby maternity colonies. As of 2026, these GNWT-ECC led capture surveys are ongoing.

Cave surveys have occurred in the Sahtu, South Slave Region and Dehcho regions with extensive surveys in NNPR. Cave surveys have included visual inspection, guano collection and DNA analysis, and acoustic monitoring. Two caves in NNPR have been confirmed as winter hibernacula for bats (Horne and Critchley 2019). This has resulted in legal protection for critical hibernation habitat in NNPR. Surveys to identify hibernacula in NNPR continued in 2025, with investigations of over 60 caves. Evidence of bats was observed in 23 caves, and as of 2026, monitoring and continued investigation of overwintering habitat in NNPR is ongoing (Murchison pers. comm. 2025 *in* CMA *in prep)*.

In May 2026, GNWT-ECC began spring monitoring for WNS, which included capture surveys at known hibernacula and maternity colonies to investigate bat health through assessment of wing condition and swabbing for Pd; and guano collection at maternity roosts to test for Pd presence. From this monitoring, GNWT-ECC confirmed the first case of WNS and Pd in the Fort Smith area of the NWT (GNWT 2026). WNS was detected in a northern myotis (GNWT 2026).

Table 2. A comprehensive list of bat research and surveys performed in the Northwest Territories since the earliest documented survey (2006).

PROJECT/COMMUNITY	SOUTH SLAVE	NORTH SLAVE	DEHCHO	SAHTU	GWICH'IN	INUVIALUIT	SURVEY TYPE	SURVEY YEARS	COLLABORATORS
GNWT spring bat surveys and WNS monitoring	X						Capture; guano collection; Pd swabs; hibernacula visit	2026	GNWT-ECC; Taiga Wildlife Research; Lark Wildlife Research
GNWT opportunistic acoustic monitoring	X	X	X	X			Acoustics	2011 - ongoing	GNWT-ECC
NABat monitoring	X	X	X				Acoustics	2021 - ongoing	GNWT-ECC; Parks Canada
Tsu Lake acoustic monitoring	X						Acoustic	2021 - ongoing	GNWT-ECC; Aurora College
Tłı̨chǫ Highway bat monitoring		X					Acoustic	2024 - ongoing	WRRB; GNWT-ECC
Nahanni National Park Reserve cave and karst surveys			X				Cave surveys; visual inspection and acoustic monitoring	2016-2019; 2025/2026	Parks Canada
Samba K'e area biodiversity survey (part of NTBMP)			X				Acoustic	2025	Northwest Territories Biodiversity Monitoring Program
Gwich'in Settlement Area biodiversity survey (part of NTBMP)					X		Acoustic	2025	Northwest Territories Biodiversity Monitoring Program
Participatory monitoring of wildlife communities (South Slave - CIMP246)	X						Acoustic	2025	Northwest Territories Cumulative Impact Monitoring Program
Prairie Creek Proposed All Season Road - Bat habitat surveys			X				Acoustic; habitat survey	2025	Canadian Zinc Corporation
Eastbalt bat presence in the Gwich'in Settlement Area					X		Acoustic	2025	Gwich'in Renewable Resources Board
Thaidene Nëné National Park Reserve bat surveys		X					Acoustic	2025	Parks Canada
North Slave Métis Alliance - advanced technologies surveying		X					Acoustics; capture	2024, 2025	North Slave Metis Alliance
Little brown myotis maternity colony surveys	X		X				Capture; colony counts; guano collection	2018-2019, 2021-2025	GNWT-ECC

PROJECT/COMMUNITY	SOUTH SLAVE	NORTH SLAVE	DEHCHO	SAHTU	GWICH'IN	INUVIALUIT	SURVEY TYPE	SURVEY YEARS	COLLABORATORS
Bat hibernaculum surveys in Wood Buffalo National Park							Bat count	2013-2024	Parks Canada
Fort Smith east of Slave River biodiversity survey (NTBMP)	X						Acoustic	2022-2024	Northwest Territories Biodiversity Monitoring Program
Mackenzie Valley Winter Road biodiversity survey (NTBMP)			X	X			Acoustic	2023-2024	Northwest Territories Biodiversity Monitoring Program
Bats and Bridges Nahanni acoustic surveys	X	X	X				Bridge surveys; guano collection	2022, 2023	WCS Canada
Nahanni National Park Reserve acoustic surveys			X				Acoustic	2021-2023	Parks Canada
Thaidene Nëné biodiversity survey (NTBMP)		X					Acoustic	2021-2023	CWS; GNWT-ECC; Parks Canada; NGOs
Norman Wells biodiversity survey (NTBMP)				X			Acoustic	2022-2023	Northwest Territories Biodiversity Monitoring Program
Dempster and Tuktoyaktuk Highways transect					X	X	Acoustics	2022	Independent researcher - Ed West
Sahtu bat survey				X			Acoustic	2021	
Ts'udé Nilįnę Tuyeta biodiversity survey (NTBMP)				X			Acoustic	2020	Northwest Territories Biodiversity Monitoring Program
Howard's Pass Access Road Baseline Wildlife Studies			X				Acoustic	2019	Chinaco - Selwyn Chihong Mining Ltd
GNWT Bats in Buildings outreach and capture surveys	X		X				Roost investigations; colony counts; capture	2019	GNWT-ECC
Edéhzhíe National Wildlife Area and Dehcho Protected Area bat surveys			X				Acoustic	2019	CWS; GNWT; Indigenous partners
Tuyilta area karst cave investigations			X				Cave surveys; acoustic roost loggers	2018	GNWT-ECC
Pine Point Project	X						Acoustics	2018	Golder Associates
Nááts'ihch'oh National Park Reserve acoustic surveys			X				Acoustic	2018	Parks Canada

PROJECT/COMMUNITY	SOUTH SLAVE	NORTH SLAVE	DEHCHO	SAHTU	GWICH'IN	INUVIALUIT	SURVEY TYPE	SURVEY YEARS	COLLABORATORS
Inuvik High Point Wind Energy Project						X	Acoustic	2018	Hemmera Envirochem Inc.; Gwich'in Land and Water Board
Lutsel K'e Dene First Nation monitoring program		X					Acoustic	2017	Lutsel K'e Dene First Nations
Samba K'e bat survey			X				Capture; colony counts; acoustics	2017	GNWT-ECC and partners
South Slave northern myotis graduate research	X		X				Acoustic; capture; colony counts; telemetry	2014-2016	University of Calgary; Parks Canada
South Slave little brown myotis graduate research	X		X				Acoustic; capture; colony counts; telemetry	2011-2013	University of Calgary; GNWT-ECC; Parks Canada
Nahanni National Park Reserve bat surveys			X				Acoustic; capture	2006	Parks Canada; Bats R Us; CPAWS

Distribution Trends

Little brown myotis and northern myotis are both widespread throughout the NWT; however, their full range extent is continually being refined as increased survey effort continues to extend the documented range. Adequate data to assess distribution trends are not available at this time.

Movements

Little brown myotis and northern myotis both undergo annual dispersal events including inter- and intra-seasonal movements using flight. During each spring and autumn, individuals migrate between winter hibernacula and summer roosts. Little brown myotis have been observed travelling the largest distances; up to 650 kilometers (km) between summer and winter roosts (range: 10-650 km; Griffin 1945; Gifford and Griffin 1960; Fenton 1969; Norquay *et al.* 2013; Sunga *et al.* 2021); and during autumn in Southeast Alaska, have been documented traveling 9km to 24km between their day roosts and nearby hibernacula (Blejwas 2023). Northern myotis typically travel shorter distances between summer and winter roosts (up to 89 km; Griffin 1940; White *et al.* 2017).

During summer, both little brown myotis and northern myotis may switch between day roost sites depending on environmental conditions, reproductive phases, and social preferences; and perform small nightly movements between day roosts and foraging sites (Garroway and Broders 2008; Patriquin *et al.* 2016; Nelson and Gillam 2017; Sunga *et al.* 2022; Sunga *et al.* 2024). Males and non-reproductive females are generally dispersed across the landscape and perform nocturnal movements between day roosts more frequently than reproductive females.

Little brown myotis

Radiotelemetry studies in the north have recorded movement distances between day roosts and evening foraging sites at greater than 5 km for little brown myotis (Yukon, Randall *et al.* 2014). Banding efforts for little brown myotis have been ongoing since 2011 in the South Slave region, mainly focusing on maternity colonies (Reimer 2013; Reimer and Kaupas 2013; Kaupas 2015). Yearly recaptures of banded females indicate that individuals show high site fidelity to their summer maternity colonies across years (Reimer and Barclay 2025; GNWT-ECC unpubl. data 2025). In addition, little brown myotis banded during summer have been observed during autumn and winter in the SSR-1 hibernaculum, including two males that had been banded during spring at a beaver pond 2 km southeast (Cox pers. comm. *in* SARC 2017). These observations suggest that individual bats are year-round residents in the area.

Northern myotis

In the NWT, reproductive northern myotis have been observed moving between 14-529 m between subsequent roost trees, switching roosts every 1-2 days (Kaupas 2016). Limited radiotelemetry studies in the north have recorded movement distances between day roosts and evening foraging sites at approximately 2.2 km for northern myotis in the NWT (Kaupas pers. comm. *in* SARC 2017).

Habitat Requirements

Little brown myotis and northern myotis are forest dwelling bats that have seasonally dependent primary habitat requirements that include: 1) summer roost and foraging habitat; 2) transitional roosts, as bats move from summer roosts to winter hibernacula and vice versa; and 3) winter hibernation sites. During summer, reproductive females form summer maternity colonies that vary in size and location by species, while males and non-reproductive females typically roost alone or in smaller groups in trees (Davis and Hitchcock 1965; Psyllakis and Brigham 2006; Johnson *et al.* 2011; Fabianek *et al.* 2015). Maternity roosts are used repeatedly over many years, allowing for information transfer and social interaction. Roost choice varies among species, but roosts can often be found in tree cavities and behind flaking bark, in rock crevices, in buildings, and under bridges (Fenton and Barclay 1980; Barclay and Brigham 1996; Caceres and Barclay 2000; Norquay *et al.* 2013; Detweiler and Bernard 2023). Myotis species tend to prefer large-diameter trees of varying decay (alive, dying, or dead trees) and with structural defects such as cavities and cracks, located in relatively open, mixed mature forest for tree roosts (Psyllakis and Brigham 2006; Olson 2011; Jung *et al.* 2014).

Winter hibernation allows for reduced energy expense during periods of low/absent prey abundance. Most known hibernation sites are caves or abandoned mines, but overwintering in rock crevices, small cavities in scree fields, and tree root wads has also been documented. There are few known hibernacula for either species in western Canada (COSEWIC 2013) and little is known about overwintering strategies of bats in the northwestern part of the country (Jung *et al.* 2014; Lausen *et al.* 2022). There are four known hibernacula in the NWT: two in the South Slave region and two in Nahanni National Park Reserve. Hibernacula in the South Slave Region are naturally-formed underground caves in karst sink holes. They are relic or inactive river caves that formed when underground water dissolved layers in the gypsum karst bedrock, after the retreat of the continental ice sheet approximately less than ten thousand years ago (Kelly pers. comm. *in* SARC 2017). The hibernacula in NNPR are in fossil solution cave systems in a canyon carved by glacial processes (Ford 1973). These two hibernacula in NNPR are designated as critical habitat under the federal *Species at Risk Act*. A karst and cave survey was completed in 2025 in NNPR, with guano collected from several caves

(Murchison pers. comm. 2025). There will be ongoing cave monitoring to determine if they are being used as hibernacula. In addition to known hibernacula, there is an unconfirmed report of approximately 200 bats overwintering in the roof of a cabin in the South Slave region of the NWT (Wilson *et al.* 2014), but the species and fate of the bats are unknown.

Hibernation sites have high relative humidity (>80%) and stable, cool temperatures (2-12^{0}C) (Rysgaard 1942; McManus 1974; Nagorsen *et al.* 1993; Webb *et al.* 1996; Speakman and Thomas 2003; Lausen and Barclay 2006a; Kunz and Reichard 2010; Vanderwolf *et al.* 2012; Perry 2013; Jung *et al.* 2014; Blejwas *et al.* 2015; Lausen *et al.* 2022). Hibernacula temperatures recorded in the NWT and in Wood Buffalo National Park, Alberta are at the low end of this temperature range and colder than those further south. The SSR-1 hibernaculum has a recorded temperature range of 2.50-2.75^{0}C and 100% relative humidity during the winter (Kelly unpubl. data 2013) and winter temperature in Walk-in Cave, Wood Buffalo National Park, fluctuated between -1.1 and 0.8^{0}C (Reimer *et al.* 2014). The temperatures in the two caves in Nahanni National Park Reserve ranged from -0.5 to 5.5°C and 0.4 to 0.9°C (Horne and Critchley 2019; see Physiology and adaptability, for more information on hibernacula temperatures).

During autumn, prior to hibernation, little brown myotis and northern myotis have been observed 'swarming' at winter hibernation sites (Fenton 1969; Schowalter 1980; Navo *et al.* 2002), which facilitates information transfer and mating behaviour (Bogdanowicz *et al.* 2012). During this time, bats often roost in trees, rock crevices, and anthropogenic structures prior to entering hibernation (Lewis *et al.* 2022; Hoff *et al.* 2024; Legros *et al.* 2024).

Little brown myotis and northern myotis typically forage in forest gaps, along edges and trails, over still water and slow-moving creeks (Crampton and Barclay 1996; Grindal and Brigham 1999; Jung *et al.* 1999; Holloway and Barclay 2000; Broders *et al.* 2003; Patriquin and Barclay 2003; Nelson and Gillam 2017; Divoll *et al.* 2022).

Larger areas cleared for farm fields, clear cuts, or as the result of large fires are generally avoided by Myotis species, perhaps to avoid the windier conditions characteristic of these cleared areas or because of their influence on prey abundance and risk of predation (Barclay and Brigham 1996; Grindal and Brigham 1999; Hogberg *et al.* 2002; Henderson and Broders 2008; Randall *et al.* 2011; Jung 2020).

With respect to habitat associations, forest age appears to be more important than forest type, with little brown and northern myotis preferring mature or old growth forests (Crampton and Barclay 1996; Sasse and Pekins 1996; Jung *et al.* 1999; Broders *et al.* 2005; Psyllakis and Brigham 2006; Henderson *et al.* 2008; Park and Broders 2012; Thomas *et al.* 2021; Thorne *et al.* 2021; Burrell and Bergeson 2022).

Species-specific habitat requirements are described in more detail below. See Interactions, and Movements, for more information on foraging methods (aerial hawking and gleaning), intra- and interspecific interactions, and roost-switching.

Little brown myotis

Throughout its range, reproductive females tend to form large maternity colonies. Group sizes of hundreds of individuals are often observed. Females exhibit strong site fidelity across years (Davis and Hitchcock 1965; Norquay *et al*. 2013). Maternity colonies are most often observed in human-made structures (Smith 1940; Anthony and Kunz 1977; Jung 2013; Randall *et al*. 2014), but have been documented in natural roosts, such as trees and rock crevices (Slough and Jung 2008; Olson and Barclay 2013; Jochum pers. comm. 2025). Past research has typically targeted colonies in buildings, and the potential importance of tree and/or rock roosts to reproductive females has yet to be determined; it is possible that natural roosts may predominate in remote parts of their range (COSEWIC 2013). Mature and old growth forests may provide ample roosting habitat (Crampton and Barclay 1996; Krusic *et al*. 1996; Jung *et al*. 1999). Reproductive female bats have been documented using rock crevices in Yukon and Alaska (Slough and Jung 2008; Slough 2009; Jochum pers. comm. 2025). All three maternity rock-roost areas identified were along water bodies, such as oxbow lakes and rivers. Summer roosts for males and non-reproductive females typically consist of rock outcrops, scree, trees, and buildings (Randall *et al*. 2014; Fabianek *et al*. 2015; Low 2022; Hilty *et al*. 2024); occasionally, males may use hibernacula as day roosts during the summer (Davis and Hitchcock 1965; Reimer *et al*. 2014). Little brown myotis typically forage (using both hawking and gleaning; see Interactions) in areas of limited clutter such as along trails, over water bodies (e.g., beaver ponds), and along forest edges (Adams 1996, 1997; Krusic *et al*. 1996; Patriquin and Barclay 2003).

In autumn, little brown myotis move towards hibernacula and roost in trees, rock crevices, and anthropogenic roosts during swarming (Lowe 2012; Neubaum 2018). These transitional tree roosts can be found in a variety of tree species including both deciduous and coniferous species (Lowe 2012). During the swarming period, little brown myotis typically roost within 13 km of the hibernaculum (Lowe 2012; Legros 2023), however this distance may depend on roost availability around hibernacula. Winter roost conditions typically observed in little brown myotis hibernacula (mines and caves) include temperatures from -4^0C to 13^0C (Webb *et al*. 1996; Horne and Critchley 2019) and a relative humidity between 73-100% (Rysgaard 1942; Perry 2013). Little brown myotis in Alaska have been observed hibernating in small cavities in scree fields and tree root wads (Blejwas *et al*. 2015).

In the NWT, maternity colonies have been documented in building attics and large artificial bat house structures, with populations of approximately 100-400 individuals (Figures 8 and 12; Reimer 2013; Wilson *et al.* 2014). During July, the period of greatest summer bat activity, daily temperature within a main maternity roost averaged 21.7^{0}C (min: 10.2, max: 39.4) (Reimer and Barclay 2024). In the NWT, building roosts are warmer than natural roosts (Kaupas 2016). At higher latitudes and elevations, warm roosts in anthropogenic structures are likely beneficial to minimize the use of torpor during reproduction (Randall *et al.* 2014; Thomas and Jung 2019; Micalizzi *et al.* 2023). However, reproductive female little brown myotis were captured in NNPR (Lausen *et al.* 2014), and the lack of anthropogenic structures in the park suggest that reproductive females are using natural roosts, such as trees and/or rock crevices. Additionally, reproductive female little brown myotis have been documented roosting in trees in northcentral Alberta (Olson 2011) and Alaska (Jochum pers. comm. 2025). In northcentral Alberta, reproductive little brown myotis formed maternity colonies large-diameter, mature trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*), in trees in a range of decay classes, using primarily radial-longitudinal splits and knot holes to enter the roost tree (Olson 2011).

Males and non-reproductive females have been observed roosting under exfoliating bark on trees, under the wood siding of buildings, and using the SSR-1 cave hibernaculum during summer (Wilson *et al.* 2014). Little brown myotis have been captured and observed foraging at open ponds and creeks, and above grassy fields and cutlines (Reimer unpubl. data 2012; Lausen *et al.* 2014), which is consistent with more southerly observations (e.g., foraging over ponds; Barclay 1991).

Little brown myotis have been confirmed to use bridge roosts at 17 bridges in the South Slave and Dehcho Regions through guano DNA analysis (Olson pers. comm. 2026). The northernmost detection was at a bridge approximately 60 km south of Wrigley. It is unknown whether these bridges are used as night roosts, day roosts for males and non-reproductive females, and/or maternity colonies.

The little brown myotis is the most commonly observed species in winter cave hibernacula in the NWT (SSR-1 and SSR-2) and farther south in Wood Buffalo National Park, Alberta (Reimer *et al.* 2014). Little brown myotis has also been confirmed at the two hibernacula in NNPR through genetic analysis from guano samples (Horne and Critchley 2019).

Figure 12. Maternity roots of little brown myotis (*Myotis lucifugus*) in buildings at (a) Thebacha cabin, and (b) at Lady Evelyn Falls campground and in (c, d) artificial 'bat boxes' (photo credit: J. Reimer).

Northern myotis

Throughout their range, reproductive females form maternity colonies in small groups (e.g., 11-88 individuals). Maternity roosts tend to be in deciduous trees (Thorne *et al.* 2021; Burrell and Bergeson 2022) such as trembling aspen and balsam poplar (Olson 2011; Andersen and Geluso 2022). Maternity colonies are typically in tree cavities and radial-longitudinal cracks (Foster and Kurta 1999; Menzel *et al.* 2002; Timpone *et al.* 2010; Johnson *et al.* 2011; Olson 2011). Reproductive females exhibit strong fidelity to maternity roosts year after year (Arnold 2007). Male and non-reproductive female northern myotis roost in mature snags, including short snags that are less than 3 m in height (Alston *et al.* 2019, Kaupas pers. comm. 2025). In Canada, the northern myotis is generally associated with boreal forests (Nagorsen and Brigham 1993). Undisturbed forest is important for both roosts and foraging, with individuals typically foraging under closed canopy rather than the less-cluttered habitat associated with little brown myotis (Carter and Feldhamer 2005; Broders *et al.* 2006; Henderson and Broders 2008). Northern myotis have also been observed using roads and open forest corridors that may provide a semi-open edge for easy travel and prey capture (Owen *et al.* 2003; Kaupas pers. comm. *in* SARC 2017).

In autumn, northern myotis migrate towards hibernacula and roost in trees, tree stumps, and rock crevices (Lowe 2012; Lewis *et al.* 2022). These transitional tree roosts can be found in both deciduous and coniferous species (Lowe 2012). During the swarming period, northern myotis roost within 8 km of the hibernaculum (Lowe 2012), however this distance may depend on roost availability around hibernacula. Winter hibernation occurs in caves similar to little brown myotis with temperatures ranging from 0.6-13.9^{0}C and relative humidity of 65% (summarized in Webb *et al.* 1996; Caceres and Barclay 2000; Perry 2013; Randall and Broders 2014). Northern myotis have also been observed overwintering in deep rock crevices at several sites (Lemen *et al.* 2016; Lewis *et al.* 2022).

In the NWT, two northern myotis maternity colonies have been studied in the Fort Smith area with the colony size ranging from 25-47 individuals (mean of 38; Kaupas 2016). This is a relatively large colony size for northern myotis. In areas where white-nose syndrome has caused populations declines, maternity colony size has also declined, which may not be sustainable for reproductive northern myotis (Kalen *et al.* 2022). Based on observations at 26 maternity roost trees in the South Slave Region, lactating northern myotis in these colonies roost in cavities or cracks of mature trembling aspen (Figure 13, below; Reimer and Kaupas 2013; Kaupas 2016). Elsewhere in their range, northern myotis also use other deciduous tree species, such as balsam poplar, when available (Vonhof *et al.* 1997; Olson *et al.* 2011; Kaupas 2015). Roost trees used by colonies in the Fort Smith area are of large diameter (diameter at breast height ranging from 17.4-38.8 centimetres (cm), average 28.2 cm) and in various states of decay, but most are alive or recently dead. Roost trees are in areas with relatively dense understories, which may be important for foraging habitat (Kaupas 2015). Reproductive females frequently move between day roosts (every 1-2 days) yet do not travel far (average 230 meters (m) between roosts; Kaupas 2015). There is now evidence of maternity colonies near Fort Liard and Fort Providence, as indicated by the capture of reproductive females at those locations (GNWT-ECC unpubl. data 2025).

Northern myotis have been confirmed to use bridge roosts at seven bridges in the South Slave and Dehcho Regions through guano DNA analysis (Olson pers. comm. 2026). This includes a sample from a bridge just south of Fort Resolution, which represents a range extension for northern myotis. It is unknown whether these bridges are used as night roosts, day roosts for males and non-reproductive females, and/or maternity colonies.

Northern myotis have been captured in the NWT at beaver ponds, creeks, and along narrow trails cutting through mixed forests (Reimer and Kaupas 2013; Lausen *et al.* 2014; Wilson *et al.* 2014).

Individuals have been observed entering and exiting the SSR-1 hibernaculum and Walk-in Cave in Wood Buffalo National Park, Alberta, suggesting that they may overwinter in these caves (Reimer *et al.* 2014; Reimer and Barclay 2024). Northern myotis were not identified through guano analysis at the two confirmed hibernacula in NNPR (Horne and Critchley 2019). However, northern myotis guano was collected from nearby caves that appear to be suitable for hibernation.

Figure 13. Two typical northern myotis roosts in the Fort Smith colony (left photo shows a frost crack roost, right photo shows a cavity roost). The orange arrows show roost entrance (reprinted with permission from Laura Kaupas).

Habitat Availability

Habitat availability for bats in the NWT has not been quantified; however, both the boreal forest and karst formations (landscape area rich in soluble minerals that is often characterized by caves and sinkholes) are important habitat for little brown myotis and northern myotis. The boreal forest provides summer roosting and foraging habitat while caves (potential winter hibernacula) are often found in karst habitat (see Habitat requirements, for other possible types of hibernation habitat).

The boreal forest covers approximately 614,000 km^2 of the NWT (Brandt 2009; Figure 14). It is unknown how much of the boreal forest is inhabited by bats, but it may be considered 'potential habitat' for the wider ranging species such as little brown and northern myotis that appear to have fewer geographical restrictions in the NWT compared to other Myotis species. Wilson *et al.* (2014) suggested that much of the southern Taiga Plains ecoregion (Figure 1) contains suitable habitat for bats, whereas the Taiga Shield supports some bats but is expected to be less suitable due to its cooler climate and more open, stunted forest. The Taiga Cordillera ecoregion also supports bats. Across ecoregions, habitat suitability for bats may reach a northern limit below the treeline due to climate (temperature and summer length) and/or availability of summer roosts (e.g., suitable trees; Wilson *et al.* 2014).

Karst formations are found throughout the NWT, with the majority of karst habitat existing in the Sahtú region, southern Nahanni National Park Reserve (NNPR), and the Wood Buffalo National Park area of the South Slave region (Figure 14; Ford 2008, 2009; Wood Buffalo National Park unpubl. report 1981). Ongoing cave surveys including the use of roost loggers are being performed in NNPR to determine the presence of additional hibernacula (Horne and Critchley 2019; Murchinson pers comm. 2025). A sighting of bats reported west of Tulít'a in March 2012 suggests that hibernacula could also be found in the Sahtú region (Wilson *et al.* 2014). Further exploration of karst terrain, and investigation of known caves in winter, could identify additional hibernacula. In addition, there are numerous abandoned mines in the NWT that may act as potential roosts and/or hibernacula but have not yet been investigated (Davis and Hitchcock 1965; Thomas *et al.* 1979; Nagorsen *et al.* 1993; Northwest Territories Geoscience Office 2013).

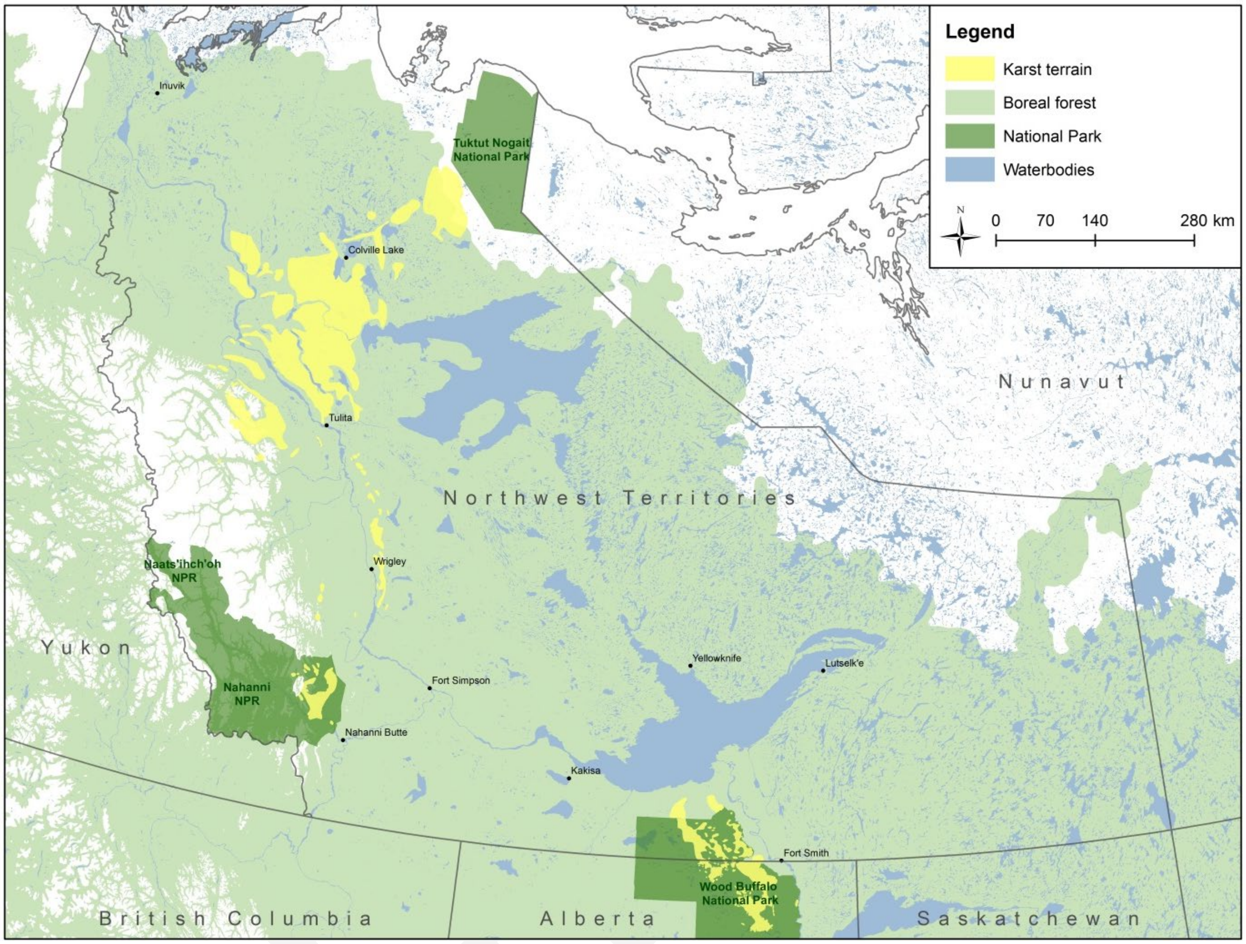

Figure 14. Potential summer (boreal forest) and winter (karst) habitat for hibernating bat species in the NWT as delineated by Brandt (2009), Ford (2008, 2009), and Wood Buffalo National Park (unpubl. report. 1981). Map created by J. Reimer (AKNHP) with permission from the NWT Protected Areas Strategy (www.nwtpas.ca) and Wood Buffalo National Park.

Habitat Trends and Fragmentation

In the NWT, the boreal forest is a continuous, large, dynamic mosaic of habitat types including mature forests important for roosting and successional forest stages that bats may use for foraging and commuting. This mosaic is maintained and renewed by fire. Boreal forest bat species are presumably well-adapted to this dynamic habitat (Loeb and O'Keefe 2011). At a local scale, forest fires may cause temporary fragmentation, displacement, and/or destruction of bat roost and foraging habitat (Figure 15; Johnson *et al.* 2012). See Threats and limiting factors - Climate change, for more information regarding the impacts of wildfires on bat populations.

From 1990 to 2023, the average total area burned per year in the NWT is 697,543 hectares (National Forestry Database 2023). Over ten recent years, from 2014-2023, the average total area burned per year is 1,054,552 hectares. Since 2014, there have been two years with extreme wildfire seasons that were characterized by large, high-severity burns. It is predicted that climate change will result in an increase in the frequency and intensity of fires, due to hotter, drier summers that provide a long fire season (Soya *et al.* 2007; Wang *et al.* 2020). As *Myotis* bats generally prefer forest cover, increased frequency of large, high-severity fires may fragment the forested landscape for bats, and may reduce roost habitat, alter corridors between foraging and roosting sites, and impact seasonal movement patterns across the landscape.

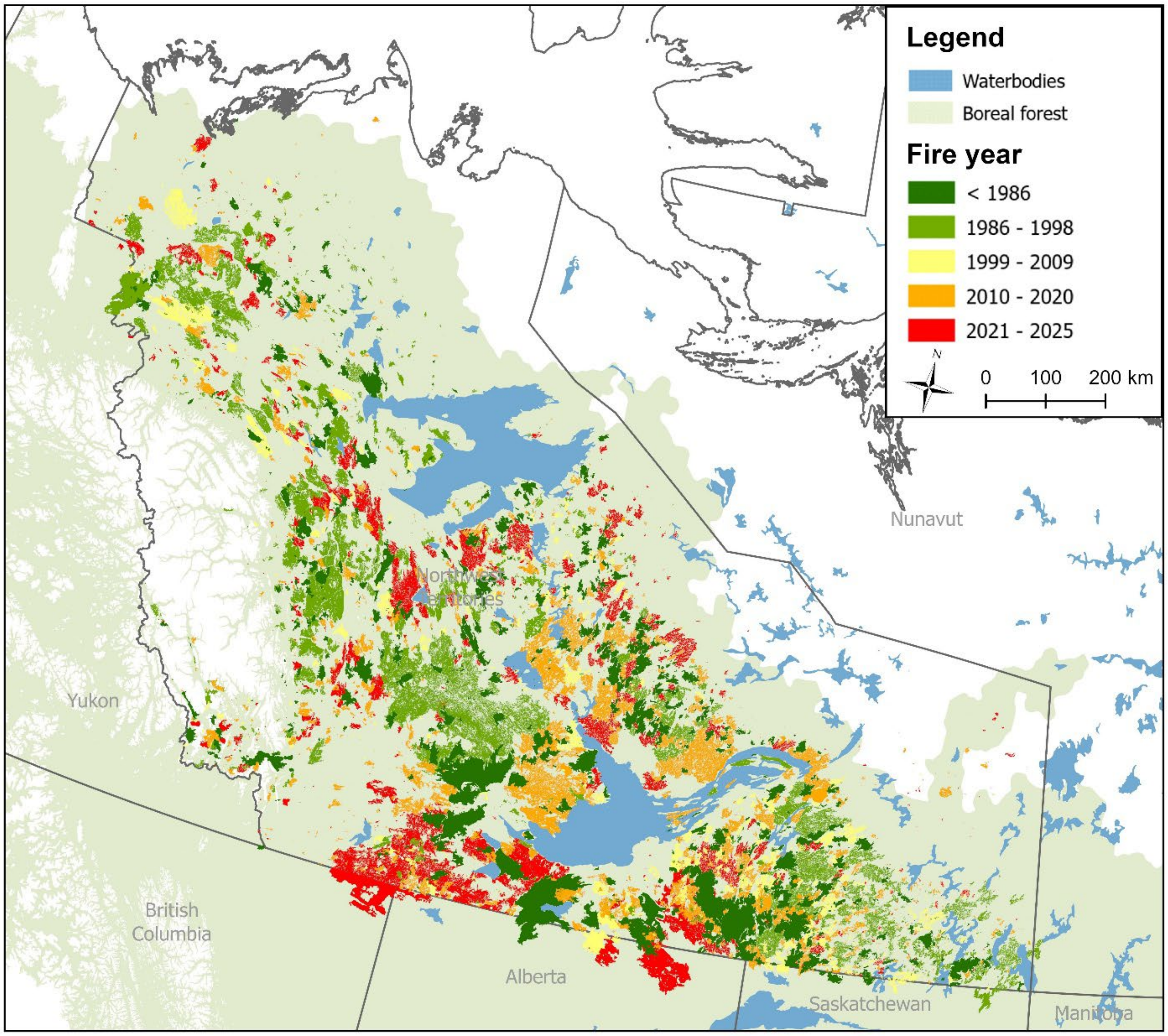

Figure 15. Fire history (1965-2025) throughout the NWT. Map created by J. Reimer (TWR) using GNWT datasets (Center for Geomatics 2025).

Additional climate change factors that may result in landscape changes and fragmentation include flooding and drought. Large-scale flooding in the South Slave Region from 2019 to 2021 resulted in substantial forest mortality (GNWT 2024). Severe drought in the southern NWT since 2022 has resulted in drought stress and mortality in trees in large areas of the South Slave Region, Dehcho and NWT section of Wood Buffalo National Park (GNWT 2024). Mortality of young trees may impact recruitment of available tree-roosting habitat, as female *Myotis* select large, mature trees. In addition, drought reduces water availability for bats (essential for hydration and prey availability) and may limit bats to "islands" of available open water during periods of drought (Geluso and Geluso 2012).

Human-created disturbances include roads, railways, power transmission, fibre optic transmission, pipelines, hydroelectric dams, seismic cut lines, trails, communities, commercial development, and resource exploration and extraction activities (ECC 2022). Two-thirds of anthropogenic landscape disturbance is from linear features such as seismic lines. While these linear features are often considered an agent for habitat fragmentation with negative impacts on local forest-dwelling animals, such as boreal caribou (Dyer *et al.* 2002), many bat species exploit linear features such as seismic lines, power lines, trails and roads, as foraging corridors (e.g., Krusic *et al.* 1996; Lippert 2001; Owen *et al.* 2003; Campbell *et al.* 2024). This behavior has been confirmed in the NWT via radio telemetry studies in the Fort Smith area that documented both little brown myotis and northern myotis traveling and foraging along power line corridors (Reimer unpubl. data 2012; Kaupas pers. comm. in SARC 2017). In addition, edge habitat is often used for roosting and foraging by northern myotis, and in the NWT, at least one lactating northern myotis was also found roosting in a tree on the edge of a power line, where the tree was exposed to high levels of solar radiation (Reimer and Kaupas 2013).

Timber harvesting can provide edge habitat along which bats forage and commute. However, little brown myotis and northern myotis avoid large open spaces in clear cuts (Patriquin and Barclay 2003; Divoll *et al.* 2022). Retained patches of trees can allow some cover for bats to commute (Hogberg *et al.* 2002). Large clear cuts may fragment bat habitat and require increased energetic investment to commute between roosting and foraging sites.

POPULATION

NWT population size estimates are not available for either little brown myotis or northern myotis, but some general conclusions may be drawn about their relative abundance globally and in Canada.

Abundance

Little brown myotis

Little brown myotis is the most common bat in much of Canada (Fenton and Barclay 1980; COSEWIC 2013), including the NWT. Capture surveys in the NWT yielded the handling of a total of 2,060 individual little brown myotis in the South Slave Region between 2011-2016, and 2021-2025 GNWT-ECC unpubl. data 2025).

The global population for little brown myotis was estimated at 6.5 million in 2006 (Frick *et al.* 2010b). In the first several years, it is estimated that over one million little brown myotis had been killed by WNS; no new estimates have been published since 2016, but the geographic extent of WNS has expanded greatly (see Threats and limiting factors). The percent of the global range of little brown myotis in Canada has been roughly estimated as 50% (COSEWIC 2013).

Northern myotis

Northern myotis is less common than little brown myotis in Canada and has a more restricted distribution (COSEWIC 2013). Capture surveys in the NWT yielded the handling of 246 individual northern myotis in the South Slave Region between 2011-2016 and 2021-2025 (GNWT-ECC unpubl. data 2025).

Global population estimates are not available for the northern myotis; however, COSEWIC (2013) estimated the pre-WNS population of northern myotis in Canada was likely over one million bats, and a rough estimate for only a portion of the midwest U.S. was over four million bats (Meinke pers. comm. 2015 *in* United States Fish and Wildlife Service [USFWS] 2015). Population declines of 90% and more have been observed in WNS-affected areas (Cheng *et al.* 2021) resulting in a much lower global population for both species. The percent of the global range in Canada has been roughly estimated as 40% for northern myotis (COSEWIC 2013).

Since bats disperse across the landscape in spring, it is difficult to estimate summer population size for either species. Winter censuses were done at the SSR-1 hibernacula from 2011 to 2015 and SSR-2 hibernacula in 2014 and 2015. These winter hibernacula surveys reported an average of approximately 2,900 over-wintering Myotis (little brown and/or northern myotis) at SSR-1 and 700 over-wintering Myotis at SSR-2 (Cox pers. comm. *in* SARC 2017). Overall population size in the NWT is likely much larger than this, since little brown myotis and northern myotis are widely distributed in the South Slave and Dehcho regions and there may be undiscovered hibernacula. It is also possible that bats from adjacent provinces or territories (e.g., Walk-in Cave, Alberta; Reimer *et al.* 2014) forage and roost in the NWT during summer and vice versa. Winter censuses have not been done for the hibernacula in Nahanni National Park.

Trends and Fluctuations

In the NWT, winter surveys performed each year between 2011 and 2015 indicate a stable population of Myotis (little brown and northern myotis) at the SSR-1 hibernaculum, with slight annual fluctuations around a population of about 2,900 bats (Cox pers. comm. *in* SARC 2017). There has been no survey access to either cave since 2016 resulting in a lack of subsequent population data, and current population trends cannot be evaluated.

Annual summer emergence count surveys (between 2011-2025) at little brown myotis maternity colonies in the South Slave region indicate stable populations (GNWT-ECC unpubl. data 2025).

Prior to large-scale impacts from WNS, population trends for little brown and northern myotis throughout their range were believed to be generally stable (Arroyo-Cabrales and Álvarez-Castañeda 2008a, b; Kunz and Reichard 2010; Olson *et al.* 2011; COSEWIC 2013), although little brown myotis and northern myotis populations face additional threats across Canada from logging and wood harvesting, drought, and wind energy (Adams *et al.* 2024). In WNS-affected areas, there have been significant population declines of greater than 90% (Kunz and Reichard 2010; COSEWIC 2013; USFWS 2015; see Threats and limiting factors – White-nose syndrome – Disease). More information is needed to understand the impact of WNS/Pd on the NWT populations of little brown and northern myotis.

Population Dynamics

Data are inadequate to estimate birth rate, recruitment rate, death/survival rate, immigration rate, and emigration rate for either the little brown myotis or northern myotis. Reproductive rates, sex ratio, age structure, and generation time is addressed in *Life Cycle and Reproduction*.

Possibility of Rescue

If population declines for little brown myotis and northern myotis occur due to an NWT-specific factor (e.g., destruction of an NWT winter hibernation site due to wildfire), it is highly likely that individuals from adjacent provinces could immigrate and repopulate the area. Little brown myotis are known to travel up to 647 km between summer and winter roosts (Norquay *et al.* 2013; see Movements) and there are no geographic features that would prohibit movement into the NWT from provinces farther south. In addition, continental genetic analysis of little brown myotis suggests gene flow between bats in the Fort Smith area and Alberta (Wilder 2014). Ongoing research into the gene flow of little brown myotis in Alaska and western Canada, including the NWT, will provide more clarity on the likelihood of rescue (Reimer pers. comm. 2025).

During summer, reproductive populations of little brown myotis and northern myotis are found in neighboring regions including northern Alberta, northeast British Columbia and

Yukon (Wilkinson *et al.* 1995; Vonhof *et al.* 1997; Vonhof and Hobson 2001; Grindal *et al.* 2011; Reimer 2013; Lausen *et al.* 2008; Slough and Jung 2008). During winter, approximately 100 bats, including little brown myotis and likely northern myotis hibernate at Walk-in Cave, immediately south of the NWT in Wood Buffalo National Park (Reimer *et al.* 2014). Despite the small size of that particular hibernaculum, it is a karst-rich area that likely provides over-wintering habitat for additional congregations. In Alberta, there are two additional known hibernacula; Cadomin Cave (approx. 670 km from the NWT) and Wapiabi Cave (approx. 830 km from the NWT; Schowalter 1980). From 2015 to 2025, the number of bats observed overwintering in Cadomin Cave ranged between 1,363 and 1,950 (Wilkinson pers. comm. 2026), however an extreme bat fatality event due to WNS occurred during the winter of 2025-2026. Little is known about bat hibernacula in northern British Columbia, and few little brown myotis hibernacula have been confirmed in southern British Columbia (Lausen *et al.* 2022). It is likely that bats overwinter in small numbers throughout British Columbia (Lausen 2022), similar to those in southeast Alaska, where small numbers of little brown myotis hibernate in small spaces between rocks in scree slopes and below the roost system of trees in holes in the soil (Blejwas *et al.* 2021). There are no known hibernacula in the Yukon. Identifying hibernation habitat across Alaska, Yukon, Northwest Territories, and British Columbia should be a priority to inform conservation planning (Jung *et al.* 2014). In general, known hibernacula are considered to be a small subset of the hibernacula that exist on the landscape.

Since individuals exhibit strong site fidelity for both summer roosts and winter hibernacula (Olson *et al.* 2011; Norquay *et al.* 2013; Slough and Jung 2020; Schorr and Siemers 2021), it may take time for new populations to establish themselves in the NWT; however, the current occurrence of bats in the NWT suggests that the current environment would be suitable for any immigrants that arrived. Since hibernation and maternity roost environments are similar across each species' range, individuals from elsewhere should be able to survive and reproduce in the NWT.

If population declines occur due to the arrival of WNS (see Threats and limiting factors), it is most likely that the adjacent provinces (e.g., Alberta and British Columbia) have also been infected with *Pseudogymnoascus destructans* (*Pd*) and will be experiencing the same population losses, limiting the amount of 'rescue' possible. The *Pd* fungus can persist in the absence of bats for a long time, which may also prevent the successful recolonization of infected hibernation sites following a decline or extirpation (Hoyt *et al.* 2015); however, populations have been reported as stabilizing in the east where WNS first attacked (Dobony and Johnson 2018) which suggests that populations may persist at low levels, allowing for population rebound (Langwig *et al.* 2017).

THREATS AND LIMITING FACTORS

White-nose syndrome - Disease

White-nose syndrome (WNS) is considered the most devastating disease for many cave-hibernating bat species in North America (Frick *et al.* 2010b; Hoyt *et al.* 2021) and is caused by the fungus *Pseudogymnoascus destructans* (*Pd*). *Pd* likely arrived in North America from Europe, where it is known to occur on bats, although without the same devastating mortality (Lorch *et al.* 2013; Zukal *et al.* 2016; Hoyte *et al.* 2021). WNS does not pose a risk to other animals or to human health. WNS predominantly affects hibernating bats (migratory bats are not as susceptible) and has been confirmed to affect 12 species including both little brown myotis and northern myotis (Blehert *et al.* 2008; White-nose syndrome Response Team 2026). It is estimated to have resulted in the deaths of 90% of little brown myotis across 36% of their range and 90% of northern myotis across 79% of their range (Cheng *et al.* 2021). It prompted the emergency assessment (2013) and listing (2014) of little brown myotis and northern myotis as Endangered in Canada (COSEWIC 2013; Species at Risk Public Registry 2015) and the listing (2023) of northern myotis as Endangered in the United States (USFWS 2023).

Pd grows in relatively warm, moist caves (optimal growth: 5-15.8ºC, growth range: 0-19ºC; Blehert *et al.* 2008; Verant *et al.* 2012), similar to the hibernacula conditions preferred by hibernating bats (Perry 2013). It is transferred between substrates in numerous ways, including from bat to bat, from cave substrate to bat, from bat to cave substrate, and by humans between sites (Coleman and Reichard 2014). *Pd* can survive in caves for long durations in the absence of bats (Lorch *et al.* 2013; Hoyt *et al.* 2015); however, recent research has shown that *Pd* loads naturally decrease on cave substrate over time (Vanderwolf *et al.* 2025).

Pd creates a cutaneous infection (infection of the skin) in bats. The diagnostic criteria for white-nose syndrome (WNS) includes characteristic histological lesions and a positive detection of *Pd* (Canada Wildlife Health Cooperative 2026). *Pd* infection and WNS disrupts torpor patterns during the winter, which depletes fat reserves and potentially causes dehydration, resulting in death (Willis *et al.* 2011; Frank *et al.* 2014; Verant *et al.* 2014). Fatality rates vary by bat species (75% - 100%; Powers *et al.* 2015) and are typically much greater for smaller bodied *Myotis* like little brown myotis and northern myotis (Francl *et al.* 2012; Frank *et al.* 2014; Mallinger *et al.* 2023).

Since its initial discovery in New York during winter 2006/2007, *Pd* and WNS have spread rapidly, at a rate of 200–900 km per year (Hoyte *et al.* 2021). In 2016 it made a 2,100 km jump to Washington from the farthest west location (Lorch *et al.* 2016). In 2025, *Pd* was found in Fort McKay, AB (Figure 16), and an extreme bat fatality event due to WNS at

Cadomin Cave (approximately 670 km from the NWT) was documented during the winter of 2025-2026.

The NWT is part of coordinated national surveillance efforts to track its spread, with support from the Canadian Wildlife Health Cooperative (CWHC) and the WNS Small Grants Program. Surveillance efforts have included collecting and testing guano (feces), swabbing captured bats, submitting dead bats for disease testing, and encouraging the public to report unusual bat observations. In May 2026, during bat monitoring efforts white-nose syndrome was confirmed in a northern myotis near Fort Smith, at a site that is also used by little brown myotis and big brown bats. Additionally, the fungus that causes WNS was detected in bat guano (feces) at Hay River (GNWT 2026; CWHC 2026; Wilson *pers. comm.* 2026). The arrival of *Pd* and WNS in the NWT was expected given rapid spread across Canada and recent detections in northern Alberta and further spread of *Pd* within the NWT is expected. Over time, it may reach and affect bat populations across the territory. The ultimate impacts of WNS on bat populations in the NWT are uncertain, as this is the first time that the disease has reached this far north. However, anticipated effects include bat mortalities at hibernation sites and declines in our bat populations. Both have the potential to be severe.

WNS now occurs throughout most of the U.S. and Canada including 40 U.S. states, 10 Canadian provinces/territories (Northwest Territories, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador), with evidence of the fungus being present in an additional 6 states and in the province of British Columbia (Figure 16 – 18; White-nose syndrome Response Team 2026; Canada Wildlife Health Cooperative 2026).

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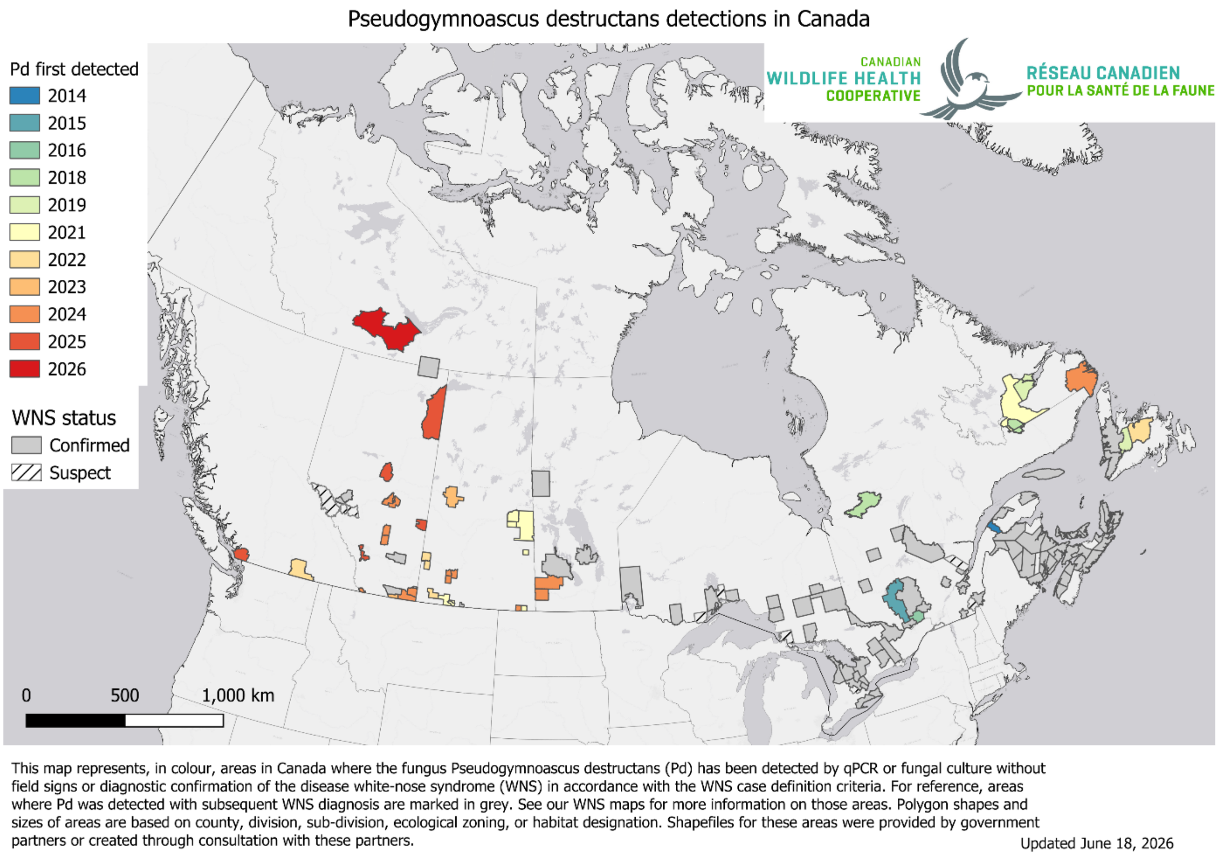

Figure 16. The range of *Pseudogymnoascus destructans* detections in Canada as of June 18, 2026 (produced by Canadian Wildlife Health Cooperative 2026). This map is frequently updated and available online: https://www.cwhc-rcsf.ca/

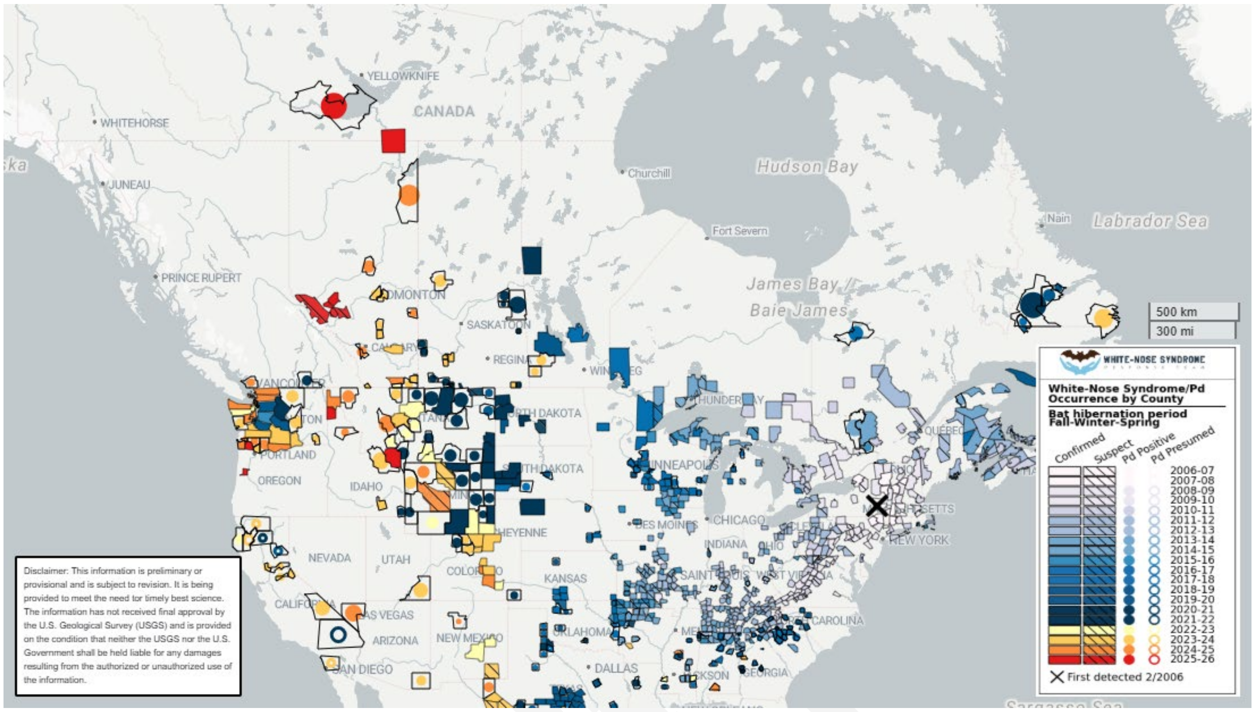

Figure 17. The range of bats affected by WNS in North America as of March 13, 2026 (produced by White-nose syndrome Response Team 2026). This map is frequently updated and available online: www.whitenosesyndrome.org.

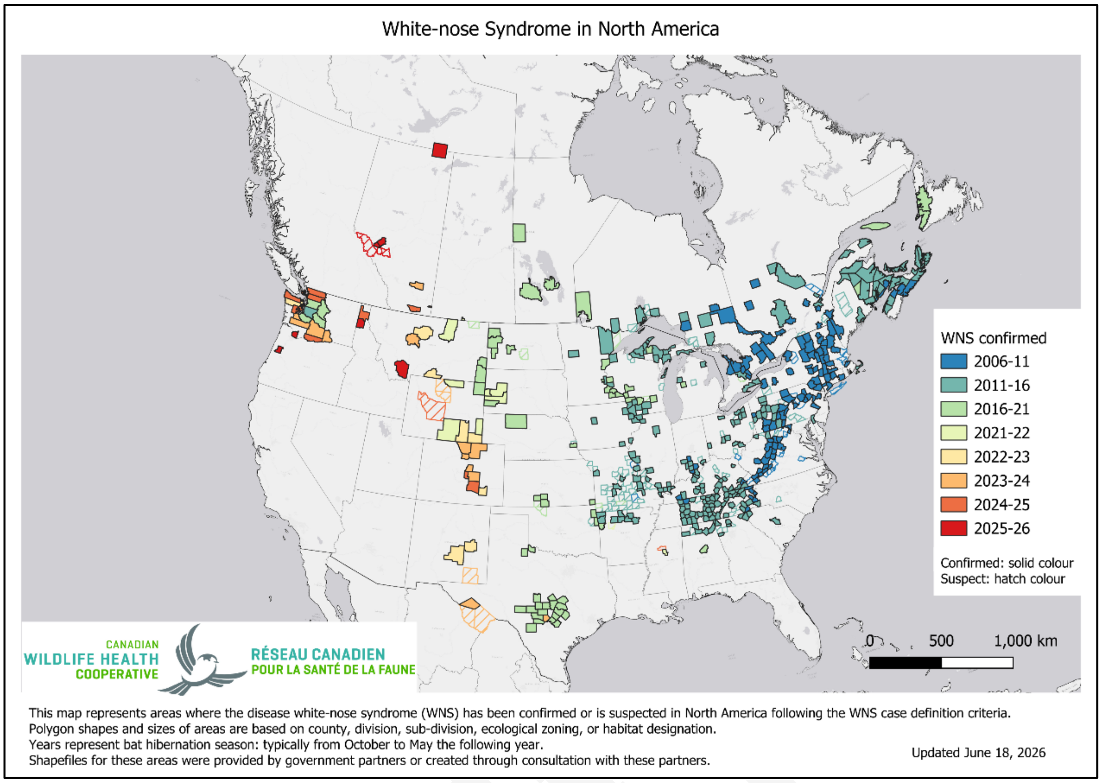

Figure 18. Confirmed and suspect white-nose syndrome (WNS) in North America and Canada as of June 18, 2026 (produced by Canadian Wildlife Health Cooperative 2026). This map is frequently updated and available online: https://www.cwhc-rcsf.ca/

Infection of *Pd* at a hibernaculum usually results in severe population decline or extirpation. Rates of decline reported for bats hibernating in Eastern Canada range from 93% to 99.8% (COSEWIC 2013). In addition, reductions of up to 80% in summer activity have been reported for little brown myotis (Dzal *et al.* 2011; Turner *et al.* 2011; Moosman *et al.* 2013; Fontaine *et al.* 2024) and 60-90% for numerous bat species, including northern myotis, in WNS-infected areas (Francl *et al.* 2012; Moosman *et al.* 2013). These reductions reflect the impact of WNS winter mortalities in these summer areas. Initial population dynamic models developed in 2010 predicted a 99% extinction of little brown myotis in northeastern North America by 2026 (Frick *et al.* 2010a), with equally devastating extinction rates for northern myotis (Langwig *et al.* 2012). These models have not been updated since their publication in 2010, however reports of population collapse continue to be published throughout their range.

Studies have shown that while fungal loads of *Pd* are relatively large on bats during hibernation, if individuals survive the winter, fungal loads begin to diminish as they migrate to their summer roost sites, with little to no fungal load remaining at the end of the summer (Langwig *et al.* 2015; Fuller *et al.* 2020). Summer roost temperatures are typically greater than the upper threshold of *Pd* and provide a temporary reprieve for survivors from WNS; however, the long term implications of increased stress on reproductive success is still unknown (Davy *et al.* 2016) and reproductive success for numerous species including northern myotis may be lower at WNS-affected sites (Pettit and O'Keefe 2017; Johnson *et al.* 2021).

In the NWT, the SSR-1 hibernaculum has a temperature range of 2.50-2.75ºC and 100% relative humidity between November and July (Kelly unpubl. data 2013). These conditions are cooler than optimal growth conditions for *Pd*; however, they fall within the range of viable growth temperatures and bats exposed to WNS at <4ºC in laboratory experiments still eventually died (Grieneisen 2011). Lab trials have shown that colder (4ºC vs. 7ºC and 10ºC) hibernacula temperatures may be more favorable for bat survival (Grieneisen at al. 2015); however, a study near the northern range limit for little brown myotis and northern myotis in Nova Scotia revealed that despite hibernacula maintaining a lower than optimal temperature for *Pd* growth, fungal growth was not slowed and WNS still impacted bats at that site (Vanderwolf and McAlpine 2021). In addition, model results suggest that WNS spread and mortality is most likely to occur in habitats that are drier and colder during winter (Flory *et al.* 2012), such as in the NWT.

Genetic studies suggest that little brown myotis populations in the west are smaller and more isolated than populations in the east (Wilder *et al.* 2015; Davy *et al.* 2017). In addition, bats in Canada west of the Rocky Mountains have different hibernation behaviour and likely hibernate singly or in small groups rather than large hibernacula (Nagorsen *et al.* 1993; Jung *et al.* 2014; Blejwas *et al.* 2015; Blejwas *et al.* 2023). This genetic isolation and the lack of large hibernacula as seen in the west could potentially slow the spread of WNS. Populations in the NWT however, use large hibernacula and have strong gene flow with the eastern populations (Alberta and Saskatchewan; Wilder 2014; Davy *et al.* 2017)

Studies have shown that bat populations in areas first impacted by WNS, such as New York, are persisting at low levels and beginning to rebound (Langwig *et al.* 2017). Genetic studies have revealed selection for genes related to the immune system and changes in metabolism during hibernation (Lilley *et al.* 2020; Gignoux-Wolfsohn *et al.* 2021); and bats that are able to carry more fat into hibernation may have higher survival rates (Cheng *et al.* 2019).

Management and mitigation actions that have been implemented include monitoring and surveillance programs (CWHC 2016) and mitigation of human fungus transfer through proper decontamination of gear (Shelley *et al.* 2011), treatment of infected bats (Meteyer *et al.* 2011; Cornelison *et al.* 2014a; Cornelison *et al.* 2014b; Gabriel 2015), reduction of mid-winter starvation and dehydration in infected bats (Foley *et al.* 2011), and modifications to hibernation environments (Boyles and Willis 2010). Direct treatment applications prove to be most beneficial when applied before or during the early epidemic stages rather than after a mass mortality event (Grider *et al.* 2022). Probiotics also show promise in being a viable treatment for WNS (Lemieux-Labonté *et al.* 2017; Hoyt *et al.* 2019; Fontaine 2021; See Positive Influences for details).

Human impacts at hibernacula

Large, underground caves are of great interest to outdoor enthusiasts and explorers; however, human disturbance during hibernation can have negative impacts on bat health and survivability (Thomas 1993; Olson *et al.* 2011). Passive disturbance (entering the cave for research or recreational purposes) during hibernation can cause bats to arouse out of torpor and use up stored fat reserves, resulting in reduced fitness and potential starvation if repeatedly disturbed throughout the season (Speakman *et al.* 1991; Thomas 1995). Industrial activities in or near hibernacula that cause noise, light or vibrations can also disturb hibernating bats and cause them to arouse from torpor (Environment Canada 2015). In addition, active disturbance of bats can cause physical harm to bats. Some caves in more southerly locations with high human traffic have gates to limit access when bats are present (i.e., winter hibernations; White and Seginak 1987) yet can still allow human exploration during summer when bats are absent.

In the NWT, the precise locations of winter hibernation sites are considered classified, and in an effort to reduce human traffic, are not readily shared with the public (Wilson pers. comm. *in* SARC 2017). Motion-sensor cameras were deployed at SSR-1 in 2013 to monitor human visitors and detected no human disturbance at the site (Cox pers. comm. *in* SARC 2017). Visits to SSR-1 and SSR-2 for research and monitoring purposes were limited to once per winter or less between 2011 and 2015 (Kelly pers. comm. *in* SARC 2017) and have not been repeated since 2015 due to land access issues.

Human activities that change hibernacula conditions (including accessibility, temperature, humidity, airflow, and hydrology) can have a negative impact on bats. This can include blocking or gating cave entrances, making modifications for tourists, decommissioning or reactivating mines, quarrying, or forestry activities that take place around hibernacula. Additionally, the use of heavy machinery (e.g., timber harvesting equipment) near weak areas of a hibernaculum could cause collapse (McAlpine 1983; Environment Canada 2015).

Exclusion and removal of maternity roosts

The effects of removing a maternity roost, or excluding bats from a roost (e.g., by sealing the entrances), depend on factors such as timing, species, and availability of additional suitable habitat. Little brown myotis excluded from a maternity roost may move to new roosts (Brigham and Fenton 1986; Brittingham and Williams 2000), but this can affect the fitness of displaced bats, including reducing their reproductive success (Brigham and Fenton 1986). Neilson and Fenton (1994) found that breeding little brown myotis females abandoned the area after their building roost was sealed and did not use other available roosts or join other colonies nearby.

If adult females are excluded (i.e., roost access is prevented) during the breeding season before their pups have fledged, juveniles will be left without food or hydration. This will most likely result in the death of all individuals inside the roost site, which could have a significant impact on local populations (Environment Canada 2015). These impacts can be avoided by sealing entrances during autumn after juveniles have fledged.

Many homeowners do not appreciate bats living in their attics and will often attempt to remove maternity colonies using non-lethal (exclusion) or lethal (extermination) methods. In the NWT, this threat is relevant primarily to little brown myotis as they are the only species documented using building roosts in the NWT thus far (see *Habitat requirements*). Public education can reduce this threat as the general fear of bats is reduced and community members are informed of the appropriate time and methods for excluding bats from their houses. Erecting well-designed, well-placed bat houses nearby, to provide alternative roosts the year after exclusion, can help bat colonies to relocate successfully (Brittingham and Williams 2000), and has been successfully implemented in the NWT at sites such as Lady Evelyn Falls campground (Wilson pers comm. 2025).

Removal of maternity roost trees may occur through timber harvesting, residential development, or any other development activity that requires clearing forested land. This threat is relevant to northern myotis in the NWT, including the maternity colony roosting in trees within the town of Fort Smith (Kaupas 2016). Several studies have documented negative impacts of roost tree loss on bats (Borkin *et al.* 2011; Chaverri and Kunz 2011). In a Kentucky forest where roosts were not limiting, northern myotis used different trees for roosting after their previous trees were removed outside the breeding season and did not abandon the area or substantially change their roosting behaviour (Silvis *et al.* 2015). However, bats did travel longer distances between subsequent roosts, suggesting higher energy expenditure in locating and commuting to suitable roost trees. Silvis *et al.* (2015) cautioned that bats' tolerance to roost loss may depend on local forest conditions, including the availability of alternate roost trees.

Removal of occupied maternity roost trees during the breeding season would likely cause mortality, although data on this are lacking. Under section 5.7.2(V) of the Commercial Timber Harvest Planning and Operations Standard Operating Procedures (Government of the Northwest Territories 2005), timber harvesting operations in the NWT are not currently permitted to occur during the migratory bird nesting season (May-August), which overlaps with the most critical window for the breeding season for bats (see *Physiology and adaptability*).

Climate change

Changing wildfire regimes

Temperatures are warming and the volume of surface water is declining in Canada's north (Spence *et al.* 2025, Baltzer *et al.* 2025). This is resulting in more frequent and severe fires. There is a lack of information regarding the impact of wildfires on bat populations in the boreal forest (see Jung 2020). Elsewhere, several studies on prescribed fires and wildfires demonstrate little impact of fire on little brown myotis and northern myotis activity and roosting behaviour, and in some cases increases in bat foraging activity in burned areas (Johnson *et al.* 2009, Lacki *et al.* 2017, Burns *et al.* 2019, Low *et al.* 2024). However, many of these studies involved prescribed fires, which result in landscape changes that are much less severe than large, high-severity wildfires. Additionally, many studies focus on the initial years after a fire, with little examination of long-term impacts on bat roosting and foraging behaviour. Baltzer *et al.* (2025) determined that long-term habitat changes due to the changing fire regime in the NWT are likely to result in a decrease in the abundance of little brown myotis and northern myotis. Occupancy modeling in a severely burned area in California demonstrated that little brown myotis occupancy is projected to decline significantly over the 100 years post-fire (Blakely *et al.* 2019). Fisher and Wilkinson (2005) suggested that while bats may use recently burned areas (<10 years) in the boreal forest for occasional foraging, a lack of roost sites results in low bat activity until a forest reaches the old growth stage (76 to >125 years). In the northern boreal forest in Yukon, little brown myotis activity was lower in an eight-year-old severe burn than in mature forest (Jung 2020). The canopy cover and number of large-diameter snags were substantially reduced in the burn compared to mature forest. Jung (2020) proposed that at northern latitudes, little brown myotis may avoid burned areas due to reduced canopy cover, as well-illuminated nights may pose a higher risk of predation. Northern myotis is a clutter-adapted species, preferring to forage within the forest, and therefore may be even more negatively impacted by large, high-severity burns than little brown myotis in the NWT (Balzter *et al.* 2025).

Different types of insect prey appear to respond to wildfire differently. Wildfire can temporarily increase aquatic emergent insect prey (Malison and Baxter 2010), which may be the driver behind initial post-fire increases in little brown myotis activity in some regions (Low *et al.* 2024). However, populations of other arthropods, such as moths and beetles, decline in response to fire (Carbone *et al.* 2019; Koivula *et al.* 2006).

Reproductive female little brown bats and northern myotis in the South Slave Region, northern Alberta, and Alaska select large-diameter, mature, deciduous trees with cavities and/or cracks (Olson 2011; Kaupas 2016; Jochum pers. comm. 2025). While there is evidence of northern myotis selecting trees within prescribed burns closer to the southern edge of their range (Johnson *et al.* 2009), little is known regarding bat roost selection after a severe wildfire. In an area in which 70% of the forests had burned, long-eared myotis (*Myotis evotis*), selected roosts almost exclusively outside of the burned area (Snider *et al.* 2013). Another Myotis species, California myotis (*Myotis californicus*), was more likely to roost in low-severity than high-severity burned areas (Doty *et al.* 2023). After a severe fire in Australia, 57-100% of large dead trees with cavities were lost and 79% of large living trees with cavities died (Lindenmayer *et al.* 2012). In the 14 years post-burn there was no recruitment of large trees with cavities in unburned or burned sites. At this site, the long span of time required for the recruitment of large, mature trees with cavities (>120 years) and wildfire and logging activities have created a "large cavity tree crisis" (Lindenmayer *et al.* 2012). Few large-diameter trees remain after high-severity burns (Jung 2020) and there are changes to the forest microclimate after burns, including greater temperature fluctuations (Wolf *et al.* 2021) and lower air moisture (Ma *et al.* 2010).

It is important to consider the climate of the northern boreal forest and the roost needs of reproductive females when examining roost availability in a post-fire landscape. In the South Slave Region, northern myotis maternity roost trees with lower canopy cover experienced lower minimum roost temperatures (Kaupas 2016), which can increase energetic requirements for reproductive females. In California, California myotis avoided roost trees in burned areas that had low canopy cover (Doty *et al.* 2023). Reproductive female little brown myotis and northern myotis roost in trees in a variety of decay stages, and northern myotis appears to prefer trees in early decay (Kaupas 2016; Olson 2011). While burned trees may provide roost habitat through hollows and sloughing bark, dead trees with less insulation, such as burned trees, have greater temperature fluctuations and lower minimum temperatures than trees early in decay (Wiebe 2001). Burned trees with low insulative capacity and open canopies are unlikely to be suitable for reproductive female little brown myotis and northern myotis.

An additional concern in the NWT is the increasing frequency of reburning, where wildfires occur in areas that burned less than 20 years prior. This reburning may prevent the recruitment of new, mature trees and forests (Baltzer *et al.* 2025).

There is little information on how bats respond to a nearby fire, particularly in the boreal forest. Dickinson *et al.* (2009) used radio-telemetry to track two northern myotis roosting in a prescribed burn. During the daytime, both bats left their tree-roosts within 10 minutes of fire ignition that occurred 20 m from their roosts. Bats alternated between flight and roosting for the remainder of the day and continued to forage after sunset. The bats flew over unburned areas, away from smoke.

Bats using torpor appear to respond to smoke (Scesny 2006), and at low ambient temperatures bats take significantly longer to respond to smoke (Doty *et al.* 2018). The severe fires in the Northwest Territories in 2023 burned late into autumn, with the largest single-day area burned on record in late September (Jain *et al.* 2024). As bats are entering hibernation in autumn, there may be energetic costs of arousing from torpor due to the presence of smoke on the landscape (Baltzer *et al.* 2025), particularly in late summer when bats are storing energy reserves for winter hibernation.

Bats living in anthropogenic structures may be impacted indirectly by fire, through smoke inhalation and possible changes to insect populations. Bats may also experience habitat loss of roosts if anthropogenic structures are lost in wildfires.

In the extreme wildfire season of 2023, there were increased reports of bats present in communities. Community members reported bats clustering on buildings and in doorways. It is possible that communities acted as refugia during the fire, and that during future severe wildfire events there may be more sightings and human-bat interaction.

While a changing wildfire regime in northern Canada is likely to negatively impact foraging and roosting habitat availability in the NWT, many questions remain regarding how more frequent and severe wildfires may impact bat and insect prey populations through habitat loss, direct mortality, and smoke inhalation.

Drought

The NWT is experiencing long-term drought conditions (beginning in 2022), particularly in southern regions, contributing to low lake and river levels (Agriculture and Agri-Food Canada 2025). Across the entire southern portion of the territory, drought intensity is classified as severe or extreme as of September 30, 2025. Periods of drought occur naturally; however prolonged drought conditions may pose a significant risk to bat species.

Open bodies of water, such as ponds, wetlands, marshes, slow flowing streams, and ephemeral pools are important sources of drinking water and emergent aquatic insect prey for bats (Rydell *et al.* 1994; Grindal *et al.* 1999; Campbell 2009). When water availability is low, bats are more concentrated on the landscape around remaining open bodies of water (Geluso and Geluso 2012). Reproductive female bats are particularly dependent on access to water (Grindal *et al.* 1999; Adams and Hayes 2008). Due to susceptibility to dehydration, lactating female bats visit water sources seven times more per night then non-reproductive females (Adams and Hayes 2008). Female little brown myotis typically select roosts within one kilometre of water sources (Psyllakis and Brigham

2006; Nelson and Gillam 2017), and northern myotis select roosts within 750 metres of water sources (Krynak 2010; Lewis *et al*. 2022). Low water availability may not impact pregnancy rates, however in years of low stream discharge rates, the frequency of lactating females declined by up to 50%, suggesting that lactation may not be supported if females do not have sufficient access to water (Adams 2010).

Insect abundance is often high at open bodies of water, leading to high rates of foraging at or near bodies of water. Drought results in declines in insect populations (Frampton *et al*. 2000; Boulton and Lake 2008), which may result in both reduced access to water and food for insectivorous bats. Reduced energy intake, particularly for bats preparing to enter hibernation, may be detrimental to future reproduction and overwinter survival.

Drought also impacts the forests that bats use for roosting and foraging, through increased risk of large and severe wildfires, water stress, and increased risk of diseases that impact trees. In the 2024 forest health surveys, drought damage was present throughout the southern NWT, and was most severe in the Dehcho Region, where 68,900 hectares of observed forest was impacted by drought (GNWT 2024). In the NWT section of Wood Buffalo National Park, the tree species that were most affected by lack of water were trembling aspen, balsam poplar, and jack pine. Bats prefer mature forest for both roosting and foraging, and the mortality of young trees may reduce tree recruitment to maturity.

Drought may also cause an increase in diseases that impact trembling aspen, a tree species used for roosting by both northern myotis and little brown myotis (Olson 2011; Kaupas 2016) The aggressive fungal disease, aspen running canker (caused by the pathogen *Neodothiora populina*), was discovered in the NWT in 2024 (GNWT 2024). While bats use dead, large-diameter aspen trees, smaller diameter trees have a higher probability of aspen running canker infection (Ruess *et al*. 2021). There may be a reduction in available roost habitat if smaller aspen are not able to mature into larger-diameter trees. Diplodia canker (*Diplodia tumefaciens*), which also infects trembling aspen, is present in the NWT. Drought increases the risk of infection and mortality by these pathogens. The impacts of Diplodia canker and aspen running canker on bat habitat are currently unknown.

Timber harvest

Timber harvest has varying degrees of impact on bat habitat depending on the species (Pauli *et al*. 2015). Forestry practices that lead to a decline in the abundance of older age forests could have a negative impact, as many bat species are more abundant in the oldest forest stands. This is likely primarily related to the availability of snags and large live trees for roosting (Barclay and Brigham 1996; Crampton and Barclay 1996; Krusic *et al*. 1996; Sasse and Pekins 1996; Jung *et al*. 1999; Broders *et al*. 2005) and structural complexity and variety of microhabitats (Regnery *et al.* 2013). The direct loss of roost trees can decrease colony size and increase the distance traveled between subsequent roosts (Silvis *et al.* 2015), which can result in increased energy expenditure. As female northern myotis switch roosts every 1-2 days but have high fidelity to a roost area (Kaupas 2016; Andersen and Geluso 2022), reproductive females likely require at least 30-60 trees for successful reproduction annually. Retaining patches of highly suitable maternity roost trees would work to mitigate impacts of timber harvesting.

Timber harvest also affects foraging habitat. Harvested areas can provide edge habitat for little brown bats to commute and forage, while northern myotis avoid clearcuts and remain in intact forest (Patriquin and Barclay 2003). At northern latitudes, where brighter nights may lead to higher predation risk in open areas, little brown bats did not show avoidance of salvage-logged areas (Thomas *et al.* 2019). Different harvesting strategies can also impact how bats use the landscape. For example, retained patches of trees within clearcuts can provide cover for commuting bats (Hogberg *et al.* 2002). *Myotis* bats, and northern myotis in particular, generally avoid large clear cuts (Hogberg *et al.* 2002; Owen *et al.* 2003; Patriquin and Barclay 2003; Divoll *et al.* 2022); however, some bats use the edges of forest patches, regeneration areas and successional forest as new foraging habitat (Hogberg *et al.* 2002; Loeb and O'Keefe 2006; Lauzon *et al.* 2025).

The NWT 2030 Energy Strategy (GNWT 2018) promotes the use of wood as a method to reduce greenhouse gas emissions from fossil fuels. Commercial timber harvesting has occurred in many locations, typically small harvest volumes by small-scale local businesses (500-10,000 m^3 per year). Forest Management Agreements (FMAs) were signed in the Fort Providence and Fort Resolution areas in 2015, with an anticipated 800 ha of harvested area per year in each FMA (ECC 2022). A reproductive female northern myotis was captured near Fort Providence in 2025 (ECC unpubl. data) inside the harvest area for the FMA (Digaa Enterprises Ltd. 2022; Figure 19 suggesting nearby maternity tree-roosts. As the FMA for the Fort Providence area includes the harvesting of both coniferous (64,900 m^3/year) and deciduous trees (22,300 m^3/year), it is important that foresters and machine operators can recognize highly suitable maternity roost trees to avoid the removal of potentially critical maternity roost habitat.

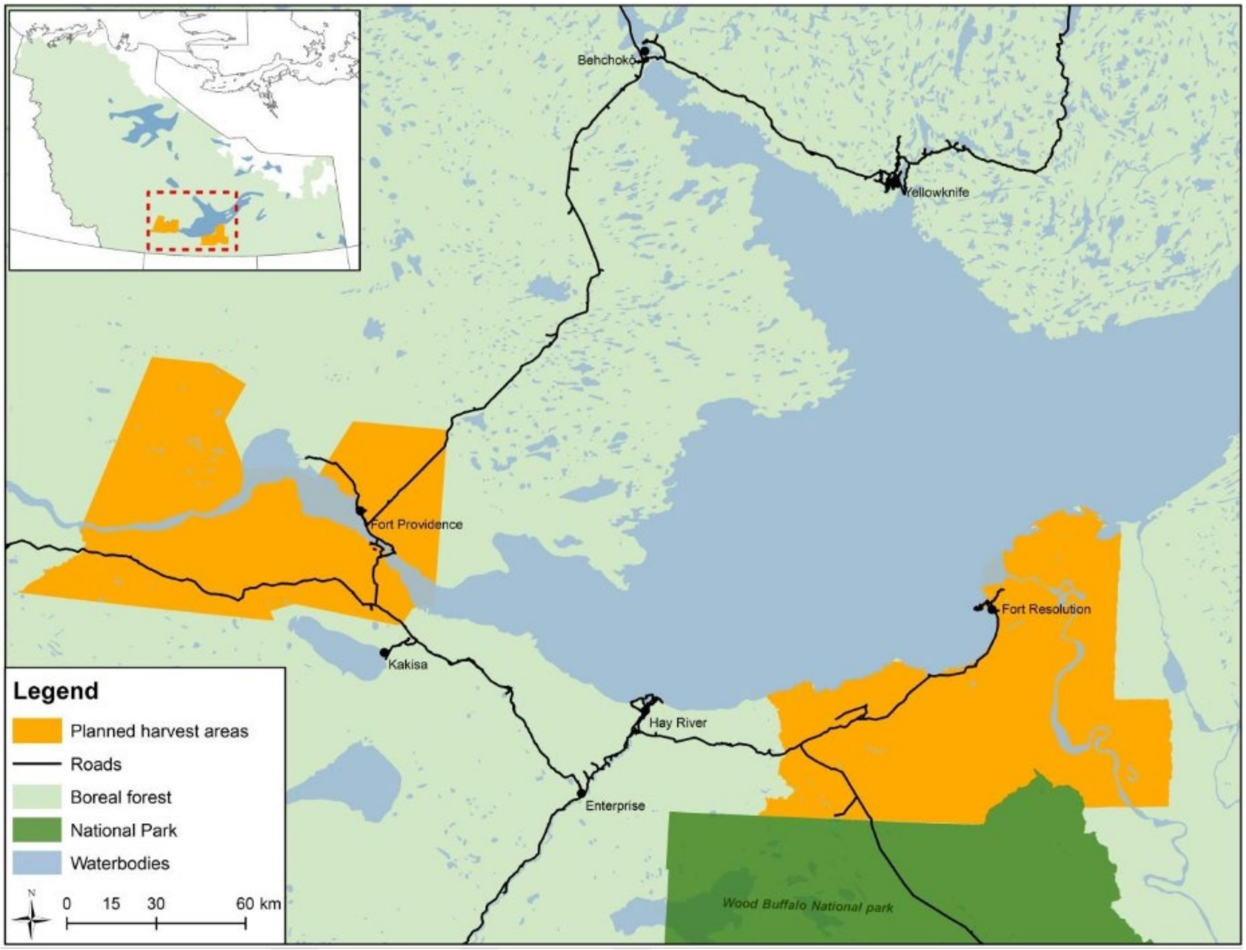

Figure 19. The 25-year timber harvest areas proposed by Timberworks and Digaa Enterprises in the South Slave region, NWT. Map created by J. Reimer using data obtained online from permit application shapefiles available through the Mackenzie Valley Land and Water Board (MVLWB) Public Registry (2025; permits 2022W0005 - formerly MV2015W0011 and MV2022W0006 - formerly MV2015W0018).

The total area harvested in the NWT has declined since the 1990s (Figure 20). Timber harvesting in the southern regions of the NWT may increase substantially if a wood pellet manufacturing facility goes ahead (ECC 2022); however, as of 2025, there is little movement on expanding the forestry industry in the NWT (Gravel, pers. comm. 2025).

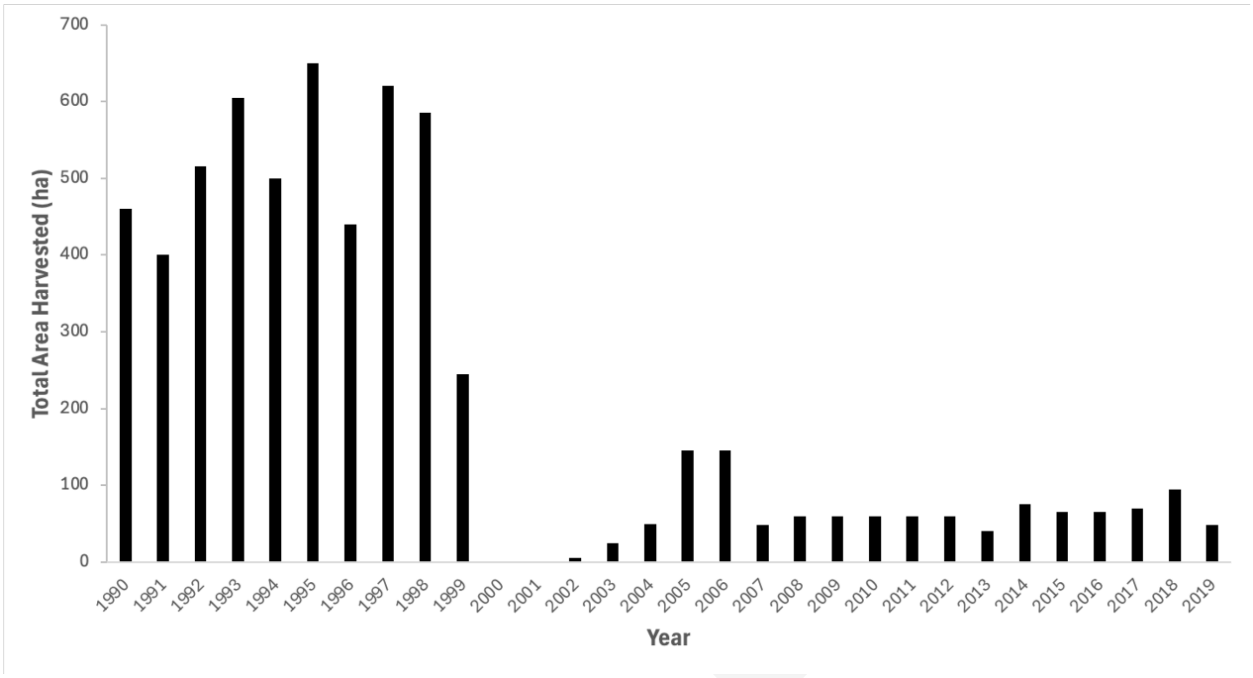

Figure 20. Historic annual timber harvest volume in the NWT from 1990-2019. Figure reproduced from the NWT State of the Environment Report (ECC 2022).

Proactive climate adaptation projects, such as the creation of firebreaks and fuel reduction, are important to reduce the likelihood of wildfire spread to communities. These practices may, however, impact the forests that are home to tree-roosting bats. For example, one of two known northern myotis maternity colony areas is found close to Fort Smith, where tree removal may be necessary to prevent the spread of wildfire.

Other potential threats

Intentional eradication (extermination) of an entire colony is a potential threat to bats in the NWT although it has not yet been reported in the territory; however, removal of individuals in the NWT has been reported (*see Interactions with Humans*). Elsewhere in Canada, some maternity colonies of bats in buildings are exterminated (using chemicals) because of noise, accumulation of feces, and fears about disease. The number of exterminations in Canada is unknown, but is likely in the hundreds of bats each year. As a maternity colony may contain most of the breeding females and offspring for a large area, colony eradication can be significant to local populations (COSEWIC 2013).

As noted in *Interactions*, common house cats prey on bats that roost in buildings (Rysgaard 1942; O'Shea *et al.* 2011; Ancillotto *et al.* 2013; Oedine *et al.* 2021). Across Canada, the most common confirmed cause of death in bats is due to trauma, and trauma is most commonly the result of predation by cats (Segers *et al.* 2025). Numerous cat-related bat fatalities have been reported in the NWT, and samples submitted to ECC in Fort Smith (Kelly pers. comm. *in* SARC 2017), but these incidences are not tracked formally and cannot be quantified. Mortality due to cats also occurs in the Yukon, with cats being known to kill juvenile little brown myotis that have recently fledged (Jung pers. comm. *in* Environment Canada 2015). Predation by cats is expected to impact bats using building roosts in or near communities, because of their proximity to cats. The impact of this threat on bat populations in the NWT is unknown but presumably small.

Outside of the NWT, wind turbines are considered a threat to various bat species. Local, non-migratory species including *Myotis* are killed at lower rates than long-distance migrant species (e.g., 0-13% of fatalities; Arnett *et al.* 2008). Zimmerling and Francis (2016) found that as of 2013 about 47,400 bats were killed each year by wind turbines in Canada, of which about 13% were little brown myotis. There are currently no large-scale wind energy developments in the NWT (GNWT 2018). The NWT 2030 Energy Strategy includes the proposed expansion of wind energy into northern regions of the territory, include the Sahtú, North Slave, and Beaufort Delta Regions.

There is a possibility that humans could transmit SARS-CoV-2 to bats through bat handling. The risk of transmission is low, particularly in open air space, and the use of facemasks while handling bats can reduce the risk of transmission by 65-88% (Cook *et al.* 2021). Bat biologists in the NWT that are handling bats wear facemasks to reduce the potential risk of transmission of SARS-CoV-2.

Mercury contamination is a potential threat to the health of bats in the NWT, as bats are particularly susceptible to mercury accumulation (Karouna-Renier *et al.* 2014; Yates *et al.* 2014; Environment Canada 2015; Little *et al.* 2015). For example, silver-haired bats with high mercury concentrations have a greater use of torpor compared to individuals with low mercury concentrations (Kuerschner 2024), which suggests a lower body condition or increased need to conserve energy. Mercury is a naturally occurring element, and atmospheric concentrations can increase due to human activities, such as the burning of fossil fuels, mining processes, and waste incineration. Mercury can be deposited in remote areas through long-range atmospheric transport (Fitzgerald *et al.* 1997) and flooding can result in increases in mercury concentrations in aquatic systems (Kelly *et al.* 1997). A study examining mercury bioaccumulation in bat fur across Canada reported that little brown myotis in the NWT had relatively low concentrations of mercury compared to eastern Canada, and no individuals in the NWT had fur mercury concentrations above the threshold for higher risk of sub-lethal effects of mercury exposure (Chételat *et al.* 2018). Canada-wide, mercury concentration in bats was positively correlated with levels of atmospheric mercury deposition, with northern myotis exhibiting higher concentrations of mercury than little brown myotis (Chételat *et al.* 2018). Insectivorous bats feeding at flooded aquatic areas, such as reservoirs, bioaccumulate higher concentrations of mercury than non-insectivorous bat species in the same area (Syaripuddin *et al.* 2014), therefore, foraging at flooded areas may also contribute to mercury concentrations in insectivorous bats. There are varying reports as to whether the cross species difference in mercury accumulation is related to differences in species-specific diet or not (Becker *et al.* 2018; Chételat *et al.* 2018; Bedard *et al.* 2023), and other factors related to their ecology and/or physiology may need to be considered.

Contaminants, such as polybrominated diphenyl ethers (PBDE's), pesticides, pharmaceuticals and personal care products have been found in tissue samples from many bat species in northeastern North America, including little brown myotis and northern myotis (Secord *et al.* 2015). Contaminants like pharmaceuticals and personal care products are likely of little concern for bats in the NWT because of the low-density human population; however, contaminants like PBDE's and pesticides, that are long-ranged transported, may pose more of a threat. PBDE's have been detected in NWT resident wildlife (Larter *et al.* 2015).

POSITIVE INFLUENCES

There is relatively little habitat loss or degradation due to anthropogenic activities within the range of little brown myotis and northern myotis in the NWT as compared to southern Canada. Bat research and monitoring efforts have continued to increase in the NWT, allowing for an increased understanding of bat species in the territory. Federal agencies (eg. Parks Canada), governments, Indigenous organizations, and renewable resource boards have also been involved in creating public awareness about bats in communities, and developing strategies such as the Management Plan for Bats in the NWT (CMA 2020).

Public education and community involvement

Public education and community involvement on bats has continued to develop, with GNWT-ECC and Parks Canada regularly presenting and providing educational materials on bats in the NWT. GNWT-ECC, NWT Species at Risk, Parks Canada, and Ecology North share information on bats on social media platforms. This includes sharing information about current bat research, general bat information, drawing attention to conservation issues, and encouraging the reporting of bat sightings. GNWT-ECC also carries out an annual social media campaign for Bat Week.

GNWT-ECC also provides information about bats to the public, governments, industry, and students through presentations, consultation, meetings, and providing educational materials (Wilson pers. comm. 2025). For example, GNWT-ECC delivered annual guest lectures on bat research and monitoring techniques to students in the Aurora College Environmental and Natural Resources Technology Program from 2021-2023. Several educational materials have been created and distributed by GNWT-ECC, including the

NWT Guide for Managing Bats in Buildings (2019), which provides best management practice guidelines to mitigate human impacts on bats. In 2023, GNWT-ECC released and presented on a guidance document for ECC Wildlife Officers on how to respond to bat encounters, bats in buildings, and how to report bat observations. In 2025, GNWT-ECC released a poster encouraging the public to respect underground habitat, such as caves, crevices, and sinkholes, that may be used for hibernation by bats. This poster also reminds the public that entering caves is prohibited in the National Parks. GNWT-ECC also advises both the public and industry on managing bats, bat habitat, and bat monitoring. GNWT-ECC continues to advise homeowners with bats presence in buildings, as well as supplies and assistance to install bat boxes. GNWT-ECC has also shared information with GNWT Infrastructure about the bridges used by bats and best management practices for bats and bridges.

In 2021 and 2024, respectively, GNWT-ECC launched two online tools – the NWT Species and Habitat Viewer and the NWT Climate Change Library. These tools allow the public to observe the range and critical habitat for at-risk bat species and find scientific information on climate change.

Through much of their educational materials and presentations, GNWT-ECC promotes the reporting of bat sightings. The public regularly reports sightings of bats from across the NWT. In addition to reporting bat sightings to GNWT-ECC, iNaturalist is an online platform that allows the public to record observations of bats that can be used by biologists and researchers to better understand the distribution of bats in the NWT. As of 2025, there are 17 recorded observations of bats in the NWT on iNaturalist, including locations as far west as Nahanni National Park Reserve, as far east as Fort Smith, and as far north as Yellowknife.

Regional workshops and community meetings, such as the Dehcho and South Slave Regional Wildlife Workshops, hold discussions on bat monitoring, research, and priorities. A confirmed bat sighting in Aklavik in 2024 prompted a community meeting to discuss bats, which allowed community members to share their experiences observing bats in the area with the Gwich'in Renewable Resources Board (Sallans pers. comm. 2025).

Other community events, such as the "Build a Maternity Bat Box Workshop" (2023), co-hosted by GNWT-ECC, Aurora College, and Thebacha Makerspace, and the Northern Whooping Crane Festival (2024) in Fort Smith have allowed the public to gain knowledge and tools to manage bats in buildings, and learn about bat monitoring and research.

Expanded monitoring programs and collaboration

GNWT-ECC has been involved in training local communities on the deployment of acoustic recording units to increase the capacity for bat monitoring throughout the NWT.

There has been growth in community involvement in bat acoustic monitoring, particularly through the NWT Biodiversity Monitoring Program (Wilson pers. comm. 2025). Developing the capacity for acoustic monitoring in local communities will increase search effort and allow for better understanding of bat species presence across the landscape.

GNWT-ECC continues to conduct annual surveys of little brown myotis maternity colonies, which can provide critical information, such as reproductive rates, movements, survival rate, and age. Additionally, GNWT-ECC and Parks Canada both contribute to the North American Bat Monitoring Program (NABat) in the South Slave Region, Dehcho Region, and Yellowknife. These annual surveys monitor for long-term changes in bat species distributions and abundance and contribute to bat monitoring on a continental scale. The GNWT-ECC collaborates and shares data with researchers and students across Canada to contribute to research on several topics, including roost use, foraging behaviour, body size, injury rates from mark-recapture work, and bat habitat suitability (Wilson pers. comm. 2025). Collaborations, such as the bridge surveys completed in partnership with Wildlife Conservation Society Canada, resulted in the expansion of the known range of northern myotis.

Organized working groups

The NWT currently participates in numerous coordinating bodies that are working towards bat conservation, including the Western Bat Working Group, Western Canada Bat Working Group, Northern Bat Working Group, Canadian Inter-Agency Bat Health Working Group, Canadian Bat Maternity Roost Protection Working Group, Canada Wildlife Health Cooperative, and North American Bat Monitoring Program (Wilson pers. comm. *in* SARC 2017; Canadian Bat Maternity Roost Protection Working Group 2024). These groups help with collaboration, sharing information on bats and WNS, and coordinating bat conservation and monitoring efforts across jurisdictions. The Canadian Bat Maternity Roost Protection Working Group created a document, published in 2024, that reviews maternity roost biology for Myotis species, and outlines an approach to better identify species-specific maternity roost habitats throughout their range.

Artificial maternity roosts

Artificial maternity roosts, such as bat boxes, can provide alternate habitat to bats if they are excluded from a roost or if the roost is removed (for example, the demolition of a home where bats are roosting). After a house fire in Hay River in 2023, little brown myotis were found roosting in a shed and bat box on a property where they had previously used the house as a roost (Wilson pers. comm. 2025). The shed and bat box provided alternate habitat after the loss of the primary roost. Additionally, two new bat boxes were installed on the property, and when the initial bat box was removed the bats were found roosting in the new bat boxes. This highlights the importance of the availability of alternate roost habitat, in case of exclusion or loss of a roost.

During autumn 2011, two large artificial nursery bat boxes were erected at the Lady Evelyn Falls campground. This project was initiated to assist the campground in relocating the maternity colony out of the campground buildings. Bats have been observed to roost in these bat boxes continually during the summer from 2012 to the most recent survey year, 2025. This project has successfully relocated a portion of the maternity colony out of the shower building without disturbing or harming the population and the installation of information placards provides the opportunity for visitors to the area to learn about the local bats.

If bat boxes are not constructed and/or mounted following recommended guidelines, there is the potential for bat boxes to reach very high temperatures, which can result in overheating, roost abandonment, and/or death (Martin-Bideguren *et al.* 2019; Crawford and O'Keefe 2021). Bats are at risk even at northern latitudes, as long periods of daylight and warm temperatures can result in temperatures that are too high for little brown myotis (Leung *et al.* 2022). Constructing and erecting bat boxes according to best management practices (Holroyd *et al.* 2023) will reduce this risk.

White-nose syndrome monitoring and probiotic treatments for white-nose syndrome prevention

All bat research and monitoring in the NWT must follow WNS decontamination protocols to prevent the spread of WNS. Additionally, the NWT *Wildlife Act* prevents the possession, transportation, and importing of bats.

The NWT is part of coordinated national surveillance efforts to track its spread, with support from the Canadian Wildlife Health Cooperative (CWHC) and the WNS Small Grants Program. Surveillance efforts have included collecting and testing guano (feces), swabbing captured bats, submitting dead bats for disease testing, and encouraging the public to report unusual bat observations. Wildlife managers have been working to guide staff and management partners in planning and implementing actions to address the disease when it arrived in the NWT. In 2024, GNWT-ECC contributed swabs from live bats to a research project that aims to prevent WNS through the probiotics, or healthy bacteria, present on bat's skin (Wilson pers. comm. 2025).

The use of probiotics to delay *Pd* growth on bats during hibernation has been implemented by Wildlife Conservation Society (WCS) Canada in BC, Alberta and Washington. Early results indicate that the probiotic cocktail being used has been successful in delaying *Pd* growth and in spreading naturally to untreated cave sites (Lausen pers. comm. 2025). Treatment development includes sourcing bacteria from local healthy bats and creating a probiotic prophylaxis consisting of four bacterial strains shown to inhibit *Pd*. This probiotic cocktail is then applied to the substrate at a maternity roost where bats encounter the cocktail and the bacterial strains are incorporated into their wing flora. This treatment is expected to delay or prevent the growth of *Pd* on the bats for enough of the winter that bats can combat the fungus and survival rates increase at infected sites. Probiotic treatments are currently being trialed in Washington, BC and Alberta (Lausen pers. comm. 2025; WCS Canada 2025b) and there are plans to catalogue the microbiome of bats in the NWT to determine whether probiotic treatments are a viable tool in the territory (Wilson pers. comm. 2025).

National listings and recovery strategy

Little brown myotis and northern myotis were emergency listed in 2014 as Endangered under the federal *Species at Risk Act* (SARA) (Species at Risk Public Registry 2015) as their survival is imminently threatened by WNS. Eastern populations of these three bat species suddenly and dramatically declined owing to this disease.

This listing means that these species are legally protected where they are found on federal lands that are under the authority of the Minister of the Environment or the Parks Canada Agency. These legal protections on federal lands prohibit human-inflicted bodily harm (e.g., killing, capture, harassment, removal) and the damage or destruction of the residence or one or more individuals. Under SARA, a protection order may be put in place if individuals and residences are not effectively protected.

Following the federal listing, a national recovery strategy was developed for these species to identify actions required to address the threats to these species (Environment Canada 2018). It also partially identifies critical habitat and includes a schedule of studies to complete the identification of critical habitat. As for individuals and residences, critical habitat on federal lands has legal protection and the NWT as a jurisdiction is expected to provide effective protection on non-federal lands. Activities likely to destroy critical habitat are identified in the species' recovery strategy. Examples of such activities could include research, timber harvest, mining operations, wind energy, caving tourism, and managing bats in buildings. In addition to identifying critical habitat, the national recovery strategy identified actions completed or underway to meet the population and distribution objectives, and provided strategic direction to recover these species (Environment Canada 2018). These strategies include monitoring and surveys, research, education and awareness, partnerships and stewardship, habitat and species conservation and management, and law and policy (Environment Canada 2018).

Action plans have been developed for 22 of Canada's national parks for little brown myotis, and 12 of Canada's national parks for northern myotis (Species at Risk Public Registry 2025). As of 2025, action plans have not been developed for the national parks in the NWT. Action plans describe the detailed recovery planning that supports the strategic directions outlined in the national recovery strategy. The action plan includes identifying critical habitat in the national park, proposed measures to protect critical habitat, and an evaluation of the socio-economic costs and benefits of the implementation of the action plan. Implementation reports that assess the progress towards meeting the objectives are completed five years after the action plan is put into effect.

Other management and action plans

The Canadian Wildlife Health Cooperative released The Canadian White-nose syndrome Action Plan (Canadian Wildlife Health Cooperative 2015). This document outlined the goals and action items of the Canadian WNS technical working groups that have been established to coordinate and organize Canada's response to WNS. In 2021, the Canadian Wildlife Health Cooperative released A National Plan to Coordinate the Management of Bat Health in Canada (Canadian Wildlife Health Cooperative 2021), to build on and replace the previous 2015 action plan. This plan outlines the objectives of the National Bat Health Program, which focuses on ensuring the presence of healthy and self-sustaining bat populations across Canada through the framework of a holistic bat health model. This national plan includes program management, bat population monitoring, assessment of bat health, and knowledge mobilization.

A Management Plan for Bats was created to recommend objectives and guide the management of bat species in the NWT (CMA 2020). Five main objectives were identified, including filling knowledge gaps, monitoring and mitigating for white-nose syndrome, preventing and reducing harm to bats due to human activities, increasing awareness, acceptance, and stewardship of bats and their habitats, and managing bats using an adaptive and collaborative approach. A five-year progress report for this Management Plan is currently being developed to report on actions taken to implement the management plan and progress towards the outlined objectives (CMA *in prep*).

GNWT-ECC has been developing a Cave Management Plan for hibernacula in the NWT. This management plan will facilitate stewardship and protection of these important hibernation sites in a changing environment.

Conservation/protected areas

The range of bats in the NWT includes areas currently under negotiation in lands, resources and self-government processes for the Dehcho First Nations, Akaitcho Dene First Nations, and the Acho Dene Koe First Nation. It is possible that some protection of bat habitat, an ecological value, could be provided through zoning and under a regional land use plan currently under development. A land use plan will describe what types of activities should occur, generally where they should take place, and terms and conditions necessary to guide land use proposals and development projects over time.

Since the initial bat species status report was completed (SARC 2017), two new national parks, Nááts'ihch'oh National Park Reserve and Thaidene Nënë National Park Reserve, have been established, which provide additional protected bat habitat. The national parks provide protection for bat habitat in the 44,807 km^2 Wood Buffalo National Park in Alberta and the NWT, the 30,050 km^2 Nahanni National Park Reserve, the 4,850 km^2 Nááts'ihch'oh National Park Reserve, and the 26,376 km^2 Thaidene Nënë National Park Reserve and Thaidene Nënë Indigenous Protected Area.

The two confirmed hibernacula in NNPR have been designated as critical habitat under the *Species at Risk Act*. Therefore, there is legal protection for these hibernacula to ensure the ecological integrity of the bat overwintering habitat.

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Jesika Reimer received her M.Sc. degree in Ecology, with a focus on northern bat ecology, from the University of Calgary, and is currently an Associate Research Specialist in the Wildlife Fish and Conservation Biology Department at the University of California, Davis. She has fifteen years of experience with bat-specific research, working in the NWT and Alaska, and has contributed significantly to understanding bat ecology at northern latitudes, through examining bat foraging behaviour, seasonal patterns of behaviour, life history at northern latitudes, and most recently, examining gene flow of bats in Alaska and western Canada to better understand the possible spread of white-nose syndrome. She has an extensive body of research on bats in the South Slave Region, including her master's thesis, numerous reports to local governments, and many peer-reviewed publications. Reimer has worked with local governments and ECC to perform bat species surveys and monitoring in the South Slave Region and has been an invited speaker at several Wildlife Workshops and Conferences in the NWT. Reimer was an NWT resident for 18 years and through her research has fostered connections with biologists, bat researchers currently working in the NWT, and community members throughout the NWT.

Laura Kaupas received her M.Sc. degree in Ecology, with a focus on northern bat ecology, from the University of Calgary, and is currently an Independent Wildlife Biologist in Golden, BC. Laura has thirteen years of bat research experience, having spent seven field seasons studying bat ecology and populations in the NWT. At northern latitudes, Laura has contributed to knowledge of northern bat ecology, including how bats respond to low temperatures in the spring and autumn, thermoregulation patterns in northern bat populations, and characterizing tree-roost habitat and foraging behaviour for the Endangered northern myotis at the northern edge of their range. Laura has been an invited speaker at Wildlife Workshops and conferences in the NWT and has published peer-reviewed research from the NWT. She has also collaborated with local communities in the NWT on research and bat outreach, including running "bat count events" to provide opportunities for community members to participate and learn more about bats.

STATUS AND RANKS

LITTLE BROWN MYOTIS (*MYOTIS LUCIFUGUS*)

Region	Coarse Filter (Ranks) To prioritize	Fine Filter (Status) To provide advice	Legal Listings (Status) To protect under species at risk legislation
Global	G3G4 – Vulnerable to Apparently secure (NatureServe 2024)	EN - Endangered (IUCN Red List Category 2018)	
Canada	N2N4B, NNRN, NNRM (NatureServe 2024)	Endangered (COSEWIC 2013)	Endangered (SARA 2014)
Northwest Territories	At Risk (NWT General Status Ranks – NatureServe 2025) S3S4 - Vulnerable to Apparently secure (NatureServe 2024)	Special concern (SARC 2017)	Special Concern (*Species at Risk (NWT) Act* 2018)
Adjacent Jurisdictions			
Saskatchewan	S4B, S4N (NatureServe 2024)		Endangered (2013)
Alberta	S3S4B, SNRN, SNRM (NatureServe 2024)	Endangered (2021)	Endangered (2021)
British Columbia	S3S4 (NatureServe 2024)		
Yukon	S3B (NatureServe 2024)		

NORTHERN MYOTIS (*MYOTIS SEPTENTRIONALIS*)

Region	Coarse Filter (Ranks) To prioritize	Fine Filter (Status) To provide advice	Legal Listings (Status) To protect under species at risk legislation
Global	G2G3 – Imperiled to Vulnerable (NatureServe 2021)	NT – Near Threatened (IUCN Red List Category 2018)	
Canada	N2N4B, NNRN, NNRM (NatureServe 2021)	Endangered (COSEWIC 2013)	Endangered (SARA 2014)
Northwest Territories	At Risk (NWT General Status Ranks 2025) S2S3 – Imperiled to Vulnerable (NatureServe 2021)	Special concern (SARC 2017)	Special Concern (*Species at Risk (NWT) Act* 2018)
Adjacent Jurisdictions			
Saskatchewan	S3 (NatureServe 2021)		
Alberta	S2S3 (NatureServe 2021)	Endangered (2021)	Endangered (2021)
British Columbia	S2S3 (NatureServe 2021)		
Yukon	S3B (NatureServe 2021)		

INFORMATION SOURCES

Adams, R.A. 1996. Size-specific resource use in juvenile little brown bats, *Myotis lucifugus* (Chiroptera: Vespertilionidae): is there an ontogenetic shift? Canadian Journal of Zoology 74:1204-1210.

Adams, R.A. 1997. Onset of volancy and foraging patterns of juvenile little brown bats, *Myotis lucifugus*. Journal of Mammalogy 78:239-246.

Adams, R.A. 2003. Bats of the Rocky Mountain West. University Press of Colorado, Boulder, CO. 289 pp.

Adams, R.A. 2010. Bat reproduction declines when conditions mimic climate change projections for western North America. Ecology 91: 2437-2445.

Adams, R.A. and M.A. Hayes. 2008. Water availability and successful lactation by bats as related to climate change in western regions of North America. Journal of Animal Ecology 77: 1115-1121.

Adams, A.M., L.A. Trujillo, C.J. Campbell, K.L. Akre, J. Arroyo-Cabrales, L. Burns, J.T.H. Coleman, R.D. Dixon, C.M. Francis, M. Gamba-Rios, V. Kuczynska, A. McIntire, R.A. Medellín, K.M. Morris, J. Ortega, J.D. Reichard, B. Reichert, J.L. Segers, M.D. Whitby, and W.F. Frick. 2024. The state of the bats in North America. Annals of the New York Academy of Sciences 1541(1): 115-128.

Agosta, S.J., D. Morton, B.D. Marsh, and K.M. Kuhn. 2005. Nightly, seasonal, and yearly patterns of bat activity at night roosts in the Central Appalachians. Journal of Mammalogy 86:1210-1219.

Agriculture and Agri-Food Canada. 2025. Canadian Drought Monitor [September 30, 2025]. Government of Canada.

Alston, J.M., I.M. Abernethy, D.A. Keinath, J.R. Goheen. 2019. Roost selection by male northern long-eared bats (*Myotis septentrionalis*) in a managed fire-adapted forest. Forest Ecology and Management 446: 251-256.

Ancillotto, L., M.T. Serangeli, and D. Russo. Curiosity killed the bat: domestic cats as bat predators. Mammalian Biology (2013): in press.

Andersen, B.R. and K. Geluso. 2022. Roosts of northern long-eared myotis (*Myotis septentrionalis*) at the western edge of the Great Plains. Western North American Naturalist 82(3): 586-595.

Anthony, E.L.P. and T.H. Kunz. 1977. Feeding strategies of the little brown bat, *Myotis lucifugus*, in southern New Hampshire. Ecology 58:775-786.

Arlettaz, R., P. Christe, A. Lugon, N. Perrin, and P. Vogel. 2001. Food availability dictates the timing of parturition in insectivorous mouse-eared bats. Oikos 95: 105-111.

Arnett, E.B., W. 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 A.D. Tankersley Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. The Journal of Wildlife Management 72:61-78.

Arnold, B.D. 2007. Population structure and sex-biased dispersal in the forest dwelling vespertilionid bat, *Myotis septentrionalis*. American Midland Naturalist 157:374-384.

Arroyo-Cabrales, J. and S.T. Álvarez-Castañeda. 2008a. *Myotis lucifugus*. The IUCN Red List of Threatened Species. Version 2014.3. Website: www.iucnredlist.org [Accessed 1 March 2015].

Arroyo-Cabrales, J. and S.T. Álvarez-Castañeda. 2008b. *Myotis septentrionalis*. The IUCN Red List of Threatened Species. Version 2014.3. Website: www.iucnredlist.org [Accessed 1 March 2015].

Baltzer, J.L., S. Haché, J. Hodson, M.R. Ahmed, S. Carrière, M. Coyle, E.J.B. McIntire, A. McLaren, E. Riordan-Short, M.R. Turetsky, J. van der Sluijs, J. Wilson, and B.K. Woodworth. 2025. Impacts of novel wildfire disturbance on landcover and wildlife in boreal North America. Frontiers in Environmental Science 13: 1504568.

Balzer, E.W., A.D. Grottoli, L.J. Phinney, L.E. Burns, K.J. Vanderwolf, and H.G. Broders. 2021. Capture rate declines of northern myotis in the Canadian Maritimes. Wildlife Society Bulletin 45(4):719-724.

Barclay, R. and M. Brigham. 1996. Bats and Forests Symposium, October 19-21, 1995, Victoria, BC. Paper 23/1996, British Columbia Ministry of Forests, Victoria, BC. 292 pp.

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

Barclay, R.M.R. and L.D. Harder. 2003. Life histories of bats: Life in the slow lane. Pp. 209-246. *in* T.H. Kunz and M.B. Fenton (eds.). Bat Ecology. University of Chicago Press, Chicago, IL.

Barclay, R.M.R., J. Ulmer, C.J.A. MacKenzie, M.S. Thompson, L. Olson, J. McCool, E. Cropley, and G. Poll. 2004. Variation in the reproductive rate of bats. Canadian Journal of Zoology 82: 688-693.

Becker, D.J., M.M. Chumchal, H.G.Broders, J.M. Korstian, E.L. Clare, T.R. Rainwater, S.G. Platt, N.B. Simmons, and M.B. Fenton. 2018. Mercury bioaccumulation in bats reflects dietary connectivity to aquatic food webs. Environmental Pollution 233: 1076-1085.

Bedard, B., B. Hickey, J. Chételat, and J.A. Mennigen. 2023. Variation in habitat use and its consequences for mercury exposure in two eastern Ontario bat species, *Myotis lucifugus* and *Eptesicus fuscus*. Ecotoxicology 32(7): 845-857.

Belwood, J.J. and M.B. Fenton. 1976. Variation in the diet of *Myotis lucifugus* (Chiroptera: Vespertilionidae). Canadian Journal of Zoology 54:1674-1678

Blakey, R.V., E.B. Webb, D.C. Kesler, R.B. Siegel, D. Corcoran, M. Johnson. 2019. Bats in a changing landscape: linking occupancy and traits of a diverse montane bat community to fire regime. Ecology and Evolution 9: 5324-5337.

Blehert, D.S., A.C. Hicks, M. Behr, C.U. Meteyer, B.M. Berlowski-Zier, E.L. Buckles, J.T.H. Coleman, S.R. Darling, A. Gargas, R. Niver, J.C. Okoniewski, R.J. Rudd, and W.B. Stone. 2008. Bat white-nose syndrome: an emerging fungal pathogen? Science 323:227-227.

Blejwas, K. 2023. Movements of little brown myotis from autumn transition roosts to hibernacula near Juneau, Alaska. Northwestern Naturalist 104(3): 266-271. https://doi.org/10.1898/NWN23-07

Blejwas, K., M. Kohan, L. Beard, and G. Pendelton. 2015. Little brown bats in Southeast Alaska hibernate in holes: implications for the spread of white-nose syndrome [Abstract]. North American Symposium of Bat Research, Monterey, CA, October 28 - 31, 2015.

Blejwas, K.M., G.W. Pendleton, M.L. Kohan, and L.O. Beard. 2021. The Milieu Souterrain Superficiel (MSS) as hibernation habitat for bats: implications for white-nose syndrome. Journal of Mammalogy 102(4): 1110-1127.

Bogdanowicz, W., K. Piksa, and A. Tereba. 2012. Hybridization hotspots at bat swarming sites. PLoS ONE 7(12): e53334. doi: 10.1371/journal.pone.0053334.

Bohning, R.A., D. Campbell and J. Grave. 1997. Forests of the Northwest Territories. [Pamphlet]. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta. 16 pp. Website: http://cfs.nrcan.gc.ca/bookstore_pdfs/20057.pdf [Accessed November 2015]

Borkin, K.M., C. O'Donnell, and S. Parsons. 2011. Bat colony size reduction coincides with clear-fell harvest operations and high rates of roost loss in plantation forest. Biodiversity and Conservation 20: 3537-3548.

Boulton, A.J. and P.S. Lake. 2008. Effects of drought on stream insects and its ecological consequences. *In* Aquatic Insects: Challenges to Populations. Wallingford, UK. 81-102.

Boyles, J.G., M.B. Dunbar, J.J. Storm and V. Brack Jr., 2007. Energy availability influences microclimate selection of hibernating bats. *Journal of Experimental Biology*, *210*(24), pp.4345-4350.

Boyles, J.G. and C.K.R. Willis. 2010. Could localized warm areas inside cold caves reduce mortality of hibernating bats affected by white-nose syndrome? Frontiers in Ecology and the Environment 8:92–98.

Boyles, J.G., L.P. McGuire, E. Boyles, J.O. Reimer, C.A. 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 and Behavior 165: 322-327.

Brack, V. and J.O. Whitaker, Jr. 2001. Foods of the northern myotis, *Myotis septentrionalis*, from Missouri and Indiana, with notes on foraging. Acta Chiropterologica 3:203-210.

Brandt, J.P. 2009. The extent of the North American boreal zone. Environmental Reviews 17:101-161.

Brigham, R.M. 1991. Flexibility in foraging and roosting behaviour by the big brown bat (*Eptesicus fuscus*). Canadian Journal of Zoology 69:117-121.

Brigham, R.M. and M.B. Fenton. 1986. The influence of roost closure on the roosting and foraging behaviour of *Eptesicus fuscus* (Chiroptera: Vespertilionidae). Canadian Journal of Zoology 64:1128-1133.

British Columbia Ministry of Environment. 2008. Conservation Data Centre mapping service. [data set]. Occurrence records for *Eptesicus fuscus*, *Myotis lucifugus*, *Myotis septentrionalis*, *Myotis evotis* and *Myotis volans*.

Brittingham, M.C. and L.M. Williams. 2000. Bat boxes as alternative roosts for displaced bat maternity colonies. Wildlife Society Bulletin 28:197-207.

Broders, H.G., G.J. Forbes, S. Woodley, and I.D. Thompson. 2006. Range extent and stand selection for roosting and foraging in forest-dwelling northern long-eared bats and little brown bats in the Greater Fundy Ecosystem, New Brunswick. Journal of Wildlife Management 70:1174-1184.

Broders, H., G. Forbes, S. Woodley, and I. Thompson. 2005. Range extent and stand selection for roosting and foraging in forest dwelling *Myotis septentrionalis* and *M. lucifugus* in the Greater Fundy Ecosystem, New Brunswick. Journal of Wildlife Management 70(5): 1174-1184.

Broders, H., G. Quinn, and G. Forbes. 2003. Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist 10: 383-398.

Buchanan, G.D. 1987. Timing of ovulation and early embryonic development in Myotis lucifugus (Chiroptera: Vespertilionidae) from northern central Ontario. American Journal of Anatomy 178(4):335-340.

Buchler, E.R. 1976. Prey selection by *Myotis lucifugus* (Chiroptera: Vespertilionidae). The American Naturalist 110:619-628.

Burnett, C.D. and T.H. Kunz. 1982. Growth rates and age estimation in *Eptesicus fuscus* and comparison with *Myotis lucifugus*. Journal of Mammalogy 63:33-41.

Burns, L.E., T.R. Frasier, and H.G. Broders. 2014. Genetic connectivity among swarming sites in the wide ranging and recently declining little brown bat (*Myotis lucifugus*). Ecology and Evolution 4:4130–4149.

Burns L.E. and H.G. Broders. 2015. Maximizing mating opportunities: higher autumn swarming activity in male versus female Myotis bats. Journal of Mammalogy 96(6): 1326-1336.

Burns, L.K.L., S.C. Loeb, and W.C. Bridges Jr. 2019. Effects of fire and its severity on occupancy of bats in mixed pine-oak forests. Forest Ecology and Management 446: 151-163.

Burrell, G.E. and S.M. Bergeson. 2022. Roosting behaviour of northern long-eared bats (*Myotis septentrionalis*) in an urban-adjacent forest fragment. Forests 13(12): 1972.

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

Cagle, F.R. and L. Cockrum. 1943. Notes on a summer colony of *Myotis lucifugus*. Journal of Mammalogy 24: 474-492.

Campbell, C.J., T.L. Cheng, K.L. Akre, A.M. Adams, D.I. Solick, A. Bennett, C. Newman, and W.F. Frick. 2024. Maximizing benefits to bat populations through management of power line corridors. Ecological Solutions and Evidence 5(4): e12392.

Campbell, S. 2009. So long as it's near water: variable roosting behaviour of the large-footed myotis (*Myotis macropus*). Australian Journal of Zoology 57: 89-98.

Canadian Bat Maternity Roost Protection Working Group. 2024. A qualitative approach for assessing the maternity roost habitats of Myotis species and tri-colored bats for wildlife management purposes. Canadian Wildlife Health Cooperative, National Office. 36 pp.

Canadian Wildlife Health Cooperative (CWHC). 2015. A national plan to manage white nose syndrome in bats in Canada. Revised February 2015. Website: www.cwhc-rcsf.ca/docs/BatWhiteNoseSyndrome-NationalPlan.pdf [Accessed November 2015].

Canadian Wildlife Health Cooperative (CWHC). 2026. Pseudogymnoascus destructans detections in Canada (map). Website: https://www.cwhc-rcsf.ca/white_nose_syndrome_reports_and_maps.php [Accessed 26 June 2026].

Carbone, L.M., J. Tavella, J.G. Pausas, and R. Aguilar. 2019. A global synthesis of fire effects on pollinators. Global Ecology and Biogeography 28: 1487-1498.

Carter, T.C. and G.A. Feldhamer. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219:259-268.

Center for Geomatics. 2015. Datasets for fire history (1965-2015) throughout the NWT. Center of Geomatics, Government of the Northwest Territories, Yellowknife, NT. Website: http://www.geomatics.gov.nt.ca/ [Accessed December 2015].

Chaturvedi, V., T. Victor, J. Okoniewski, X. Li, E. Ferri, C. Gunsch, P. Ren, and S. Chaturvedi. 2012. Identifying the natural habitat of *Geomyces destructans*, the etiological agent of bat geomycosis. Abstract. 5th Annual White-nose syndrome Symposium, June 4-7, 2012, Madison, Wisconsin.

Chaverri, G. and T. Kunz. 2011. Response of a specialist bat to the loss of the critical resource. PLoS ONE 6(12): e28821.

Cheng, T.L., A. Gerson, M.S. Moore, J.D. Reichard, J. DeSimone, C.K. Willis, W.F. Frick, and A.M. Kilpatrick. 2019. Higher fat stores contribute to persistence of little brown bat populations with white-nose syndrome. Journal of Animal Ecology 88(4): 591-600.

Cheng, T.L., J.D. Reichard, J.T. Coleman, T.J. Weller, W.E. Thogmartin, B.E. Reichert, A.B. Bennett, H.G. Broders, J. Campbell, K. Etchison, and D.J. Feller. 2021. The scope and severity of white-nose syndrome on hibernating bats in North America. Conservation Biology 35(5): 1586-1597.

Chételat, J., M.B.C. Hickey, A.J. Poulain, A. Dastoor, A. Ryjkov, D. McAlpine, K. Vanderwolf, T.S. Jung, L. Hale, E.L.L. Cooke, D. Hobson, K. Jonasson, L. Kaupas, S. McCarthy, C. McClelland, D. Morningstar, K.J.O. Norquay, R. Novy, D. Player, T. Redford, A. Simard, S. Stamler, Q.M.R. Webber, E. Yumvihoze, and M. Zanuttig. 2018. Spatial variation of mercury bioaccumulation in bats of Canada linked to atmospheric mercury deposition. Science of the Total Environment 626: 668-677.

Coleman, J.T.H. and J.D. Reichard. 2014. Bat white-nose syndrome in 2014: a brief assessment seven years after the discovery of a virulent fungal pathogen in North America. Outlooks on Pest Management, December 2014:374-377.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013. COSEWIC assessment and status report on the little brown myotis *Myotis lucifugus*, northern myotis *Myotis septentrionalis* and tri-colored bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. xxiv + 93 pp.

Conference of Management Authorities (CMA). 2020. Management Plan for Bats in the Northwest Territories. Conference of Management Authorities, Yellowknife, NT.

Conference of Management Authorities (CMA). In prep. Draft Progress Report on the Management of Bats in the Northwest Territories (2021-2025). Conference of Management Authorities, Yellowknife, NT.

Constantine, D.G. 2009. Bat rabies and other lyssavirus infections. Reston, VA., U.S. Geological Survey Circular 1329, 68 p.

Cook, J.D., E.H.C. Grant, J.T.H. Coleman, J.M. Sleeman, M.C. Runge. 2021. Risks posed by SARS-CoV-2 to Northern American bats during winter fieldwork. Conservation Science and Practice 3(6): e410.

Cornelison, C.T., M.K. Keel, K.T. Gabriel, C.K. Barlament, T.A. Tucker, G.E. Pierce, and S.A. Crow. 2014a. A preliminary report on the contact-independent antagonism of *Pseudogymnoascus destructans* by *Rhodococcus rhodochrous* strain DAP96253. BMC Microbiology, published online: DOI 10.1186/s12866-014-0246-y.

Cornelison, C.T., K.T. Gabriel, C. Barlament, and S.A. Crow Jr. 2014b. Inhibition of *Pseudogymnoascus desctructans* growth from conidia and mycelial extension by bacterially produced volatile organic compounds. Mycopathologia 177(1-2): 1-10.

Crampton, L. and R. Barclay. 1996. Habitat selection by bats in fragmented and unfragmented aspen mixedwood stands of different ages. Pp. 238-259 *in* M. Brigham and R. Barclay (Eds.). Bats and Forests Symposium, October 19-21, 1995, Victoria, BC. Paper 23/1996. British Columbia Ministry of Forests, Victoria, BC. 292 pp.

Crawford, R.D. and J.M. O'Keefe. 2021. Avoiding a conservation pitfall: Considering the risks of unsuitably hot bat boxes. Conservation Science and Practice 3(6): e412.

Currie W.B., M. Blake, and W.A. Wimsatt. Fetal development, and placental and maternal plasma concentrations of progesterone in the little brown bat (*Myotis lucifugus)*. Reproduction 82(1):401-407.

Czenze, Z.J. and H.G. Broders. 2011. Ectoparasite community structure of two bats (*Myotis lucifugus* and *M. septentrionalis*) from the maritimes of Canada. Journal of Parasitology Research, doi: 10.11.1155/2011/341535.

Czenze, Z.J., K.A. Jonasson and C.K. Willis. 2017. Thrifty females, frisky males: winter energetics of hibernating bats from a cold climate. Physiological and Biochemical Zoology, 90(4), pp.502-511.

Davis, W.H. and H.B. Hitchcock. 1965. Biology and migration of the bat, *Myotis lucifugus*, in New England. Journal of Mammalogy 46:296-313.

Davis, W.H. and O.B. Reite. 1967. Responses of bats from temperate regions to changes in ambient temperature. Biological Bulletin 132:320-328.

Davy, C.M., M.E. Donaldson, Y. Rico, C.L. Lausen, K. Dogantzis, K. Ritchie, C.K. Willis, D.W. Burles, T.S. Jung, S. McBurney, and A. Park. 2017. Prelude to a panzootic: Gene flow and immunogenetic variation in northern little brown myotis vulnerable to bat white-nose syndrome. Facets 2(2): 690-714.

Detweiler, L.W. and R.F. Bernard. 2023. Wildlife use of anthropogenic structures: a comprehensive review of bridge use by bats. Acta Chiropterologia 25(1): 135-157.

Dick, C.W., M.R. Gannon, W.E. Little, and M.J. Patrick. 2003. Ectoparasite associations of bats from Central Pennsylvania. Journal of Medical Entomology 40:813-819.

Dickinson, M.B., M.J. Lacki, and D.R. Cox. 2009. Fire and the Indiana bat. *In* Proceedings of the 3rd Fire in Eastern Oak Forests Conference, 20–22 May 2008, Carbondale, Ill.. Edited by Todd Hutchinson. U.S. For. Serv. Gen. Tech. Rep. NRS-P-46. pp. 5175.

Digaa Enterprises Ltd. 2022. Five Year Timber Harvest Plan. Land Use Permit MV2022W0006. 56 pp.

Divoll, T.J., S.P. Aldrich, G.S. Haulton, and J.M O'Keefe. 2022. Endangered *Myotis* bats forage in regeneration openings in a managed forest. Forest Ecology and Management 503: 119757.

Dobony, C.A. and J.B. Johnson. 2018. Observed resiliency of little brown myotis to long-term white-nose syndrome exposure. Journal of Fish and Wildlife Management, 9(1), pp.168-179.

Doty, A.C., R.D. Crawford, and R.V. Blakey. 2023. Bat roosting strategies and torpor expression in a wildfire-affected landscape during summer. Fire Ecology 19: 39.

Doty, A. C., S.E. Currie, C. Stawski, and F. Geiser. 2018. Can bats sense smoke during deep torpor? Physiology & Behavior 185: 31-38.

Dyer, S.J., J.P O'Neill, S.M. Wasel, and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. Canadian Journal of Zoology 80: 839–845.

Dzal, Y.A. and R.M. Brigham. 2012. The trade-off between torpor use and reproduction in little brown bats (*Myotis lucifugus*). Journal of Comparative Physiology B 183:279-288.

Dzal, Y., L.P. McGuire, N. Veselka, and M.B. Fenton. 2011. Going, going, gone: the impact of white-nose syndrome on the summer activity of the little brown bat (*Myotis lucifugus*). Biology letters 7:392-394.

Ecosystem Classification Group. 2007 (rev. 2009). Ecological regions of the Northwest Territories – Taiga Plains. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. viii + 173 pp. + folded insert map.

Ecosystem Classification Group. 2008. Ecological regions of the Northwest Territories – Taiga Shield. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. viii + 146 pp. + insert map.

Ecosystem Classification Group 2010. Ecological regions of the Northwest Territories – Cordillera. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. X + 170 p. + insert map.

Ecosystem Classification Group. 2012. Ecological regions of the Northwest Territories – Southern Arctic. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. x + 170 pp. + insert map.

EDI Environmental Dynamics Inc. (EDI). 2021. Howard's Pass Access Road Baseline Wildlife Studies: 2019-2020 Annual Report. Prepared by EDI Environmental Dynamics Inc. for Selwyn Chihong Mining Ltd.

Environment and Climate Change (ECC). 2022. NWT State of the Environment Report. Government of the Northwest Territories, Yellowknife, NWT, Canada.

Environment Canada. 2015. Recovery strategy for little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), and tri-colored bat (*Perimyotis subflavus*) in Canada [Draft]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. viii + 111 pp.

Environment and Natural Resources (ENR). 2014b. Bat species range map shape files (*Myotis lucifugus, Myotis septentrionalis*). Available from: Wildlife Biologist (Species at Risk), Environment and Natural Resources, Government of the Northwest Territories, PO Box 1320, Yellowknife NT, X1A 2L9, SARA@gov.nt.ca.

Environment and Climate Change (ECC), unpubl. data. 2015. Acoustic monitoring records from SSR-1 and SSR-2 bat hibernacula, South Slave region, NWT. Environment and Natural Resources, Government of the Northwest Territories, Fort Smith, NT.

Environment and Climate Change (ECC), unpubl. data. 2016a. Acoustic monitoring records from bat detectors in the South Slave, Dehcho, Sahtú and North Slave regions, NWT. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT.

Environment and Climate Change (ECC). 2016b. NWT Wildlife Management Information System. Project 250 – NWT – bat observations 1907 to present. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT.

Environment and Climate Change (ECC), unpublished data. 2025a. Monitoring of four little brown myotis maternity colonies (2011/2018-2025). Data provided by J. Wilson (Wildlife Biologist, Species at Risk). Unpublished data, October 2025. Government of the Northwest Territories, Yellowknife, NT.

Environment and Climate Change (ECC), unpublished data. 2025b. Bat records in the NWT compiled for the Wildlife Management Information System (WMIS). Data provided by J. Wilson (Wildlife Biologist, Species at Risk). Unpublished data, December 2025. Government of the Northwest Territories, Yellowknife, NT.

Environment and Climate Change (ECC), unpublished data. 2026. Results of ultrasound acoustic monitoring done opportunistically and for the North American Bat Monitoring Program (NABat). Data provided by J. Wilson (Wildlife Biologist, Species at Risk). Unpublished data, February 2026. Government of the Northwest Territories, Yellowknife, NT.

Fabianek, F., M.A. Simard, E.B Racine, and A. Desrochers. 2015. Selection of roosting habitat by male *Myotis* bats in a boreal forest. Canadian Journal of Zoology 93(7): 539-546.

Feldhamer, G.A., T.C. Carter, and S.K. Carroll. 2001. Timing of pregnancy, lactation, and female foraging activity in three species of bats in southern Illinois. Canadian Field-Naturalist 115: 420-424.

Fenton, M.B. 1969. Summer activity of *Myotis lucifugus* (Chiroptera: Vespertilionidae) at hibernacula in Ontario and Quebec. Canadian Journal of Zoology 47:597-602.

Fenton, M.B. and R.M. Barclay. 1980. *Myotis lucifugus*. Mammalian Species 142:1-8.

Fenton, M.B., I.L. Rautenbach, S.E. Smith, C.M. Swanepoel, J. Grosell, and J. van Jaarsveld. 1994. Raptors and bats: threats and opportunities. Animal Behaviour 48:9-18.

Fenton, M.B., S.B. Peck, and R.G. Syme. 1973. A biological survey of caves in and around Nahanni National Park, NWT, Canada. Canadian Caver 5: 35-42.

Fisher, J.T. and L. Wilkinson. 2005. The response of mammals to forest fire and timber harvest in the North American boreal forest. Mammal Review 35:51-81.

Fisheries & Wildlife Management Information System (FWMIS). 2015. Alberta bat occurrence data records [spatial data - excel spreadsheet]. Alberta Environment and Sustainable Resource Development, Government of Alberta, Edmonton, AB.

Fitzgerald, W.F., D.R. Engstrom, R.P. Mason, and E.A. Nater. 1997. The case for atmospheric mercury contamination in remote areas: a critical review. American Chemical Society, published on web on 01/01/1998.

Flory, A.R., S. Kumar, T.J. Stohlgren, and P.M. Cryan. 2012. Environmental conditions associated with bat white-nose syndrome mortality in the North-Eastern United States. Journal of Applied Ecology 49:680–689.

Foley, J., D. Clifford, K. Castle, P. Cryan, and R.S. Ostfeld. 2011. Investigating and managing the rapid emergence of white-nose syndrome, a novel, fatal, infectious disease of hibernating bats. Conservation Biology 25:223-231.

Fontaine, N. 2021. Probiotic application of symbiotic bacteria isolated from western bat species onto captive and field bats to prevent white-nose syndrome. M.Sc. Thesis, Thompson Rivers University, Kamloops, British Columbia.

Fontaine, A., G. Larocque, K.H. Elliott, and A. Simard. 2024. The Neighbourhood Bat Watch project reveals that rapid declines of bats after white-nose syndrome are exacerbated by a high rate of colony exclusion. Canadian Journal of Zoology 103:1-11.

Ford, D.C. 1973. Development of the canyons of the South Nahanni River, NWT. Canadian Journal of Earth Sciences 10(3): 366-378.

Ford, D. 2008. Survey of karst landforms in the Sahtú region. NWT Protected Areas Strategy, Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 231 pp. Website: http://www.nwtpas.ca/science-karst.asp [Accessed December 2015].

Ford, D. 2009. Mapping known and potential karst areas in the Northwest Territories, Canada. Prepared for Environment and Natural Resources, Government of the Northwest Territories. McMaster University, Hamilton, ON. 65 pp.

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 80:659-672.

Frampton, G.K. P.J. Van Den Brink, and P.J.L. Gould. 2000. Effects of spring drought and irrigation on farmland arthropods in southern Britain. Journal of Applied Ecology 37: 865-883.

Francis, C.M. and N.B. Simmons, on behalf of the G.B.T.W.G. of the IUCN SSC Bat Specialist Group. 2022. On the taxonomy of *Myotis lucifugus*. https://doi.org/10.5281/zenodo.7338575.

Francl, K.E., W.M. Ford, D.W. Sparks, and V. Brack, 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.

Frank, C.L., A. Michalski, A.A. McDonough, M. Rahimian, R.J. Rudd, and C. Herzog. 2014. The resistance of a North American bat species (*Eptesicus fuscus*) to white-nose syndrome (WNS). PloS one 9: e113958.

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 329:679-682.

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 79:128-136.

Fuller, N.W., L.P. McGuire, E.L. Pannkuk, T. Blute, C.G. Haase, H.W. Mayberry, T.S. Risch, and C.K. Willis. 2020. Disease recovery in bats affected by white-nose syndrome. Journal of Experimental Biology 223(6): p.jeb211912.

Gabriel, K. 2015. WNS-treated bats released into wild. CrowLab, Georgia State University. Website: http://sites.gsu.edu/crowlab/2015/05/21/WNS-treated-bats-released-into-wild/ [Accessed August 2016].

Garroway, C.J. and H.G. Broders. 2008. Day roost characteristics of northern long-eared bats (*Myotis septentrionalis*) in relation to female reproductive status. Ecoscience 15:89-93.

Geluso, K.N. and K. Geluso. 2012. Effects of environmental factors on capture rates of insectivorous bats, 1971-2005. Journal of Mammalogy 93: 161-169.

Geluso, K. C.A. Lemen, P.W. Freeman, B.R. Andersen, J.A. White, and H.M. Johnson. 2019. Variation in reproductive timing for the northern long-eared myotis (*Myotis septentrionalis*) across Nebraska. Western North American Naturalist 79(4): 571-586.

Gifford, C.E. and D.R. Griffin. 1960. Notes on homing and migratory behavior of bats. Ecology 41:378-381

Gignoux-Wolfsohn, S.A., M.L. Pinsky, K. Kerwin, C. Herzog, M. Hall, A.B. Bennett, N.H. Fefferman, and B. Maslo. 2021. Genomic signatures of selection in bats surviving white-nose syndrome. Molecular Ecology 30(22): 5643-5657.

Girard, K., H. Hitchcock, G. Edsall, and R. MacCready. 1965. Rabies in bats in southern New England. New England Journal of Medicine 272: 75-80.

Golder Associates. 2018. Pine Point Project 2018 Wildlife Studies. Report prepared by Golder Associates Ltd. for Pine Point Mining Limited.

Government of the Northwest Territories (GNWT). 2005. Commercial Timber Harvest Planning and Operations Standard Operating Procedures Manual. Environment and Natural Resources, Yellowknife, Northwest Territories.

Government of the Northwest Territories (GNWT). 2018. GNWT 2030 Energy Strategy: a path to more affordable, secure and sustainable energy in the NWT. Department of Infrastructure, Yellowknife, Northwest Territories.

Government of the Northwest Territories (GNWT). 2019. Got Bats? NWT Guide for Managing Bats in Buildings. Environment and Natural Resources, Yellowknife, NT.

Government of the Northwest Territories (GNWT). 2024. 2024 Northwest Territories Forest Health Report. Yellowknife, Northwest Territories.

Government of the Northwest Territories (GNWT). 2026. White-Nose Syndrome and the fungus that causes white-nose syndrome in bats found in the Northwest Territories– what you need to know. Public Service Announcement, Department of Environment and Climate Change, Yellowknife, Northwest Territories. Available online: https://www.gov.nt.ca/en/newsroom/white-nose-syndrome-and-fungus-causes-white-nose-syndrome-bats-found-northwest-territories

Government of Yukon. 2011. Yukon Bats, brochure. Website: maps/documents/yukonbats_brochure.pdf [accessed September 2016].

Gravel, M. pers. comm. 2025. Email exchange via Pete Cott. October 2025. Forest Management Division, Environment and Climate Change, Government of the Northwest Territories, Yellowknife, NT.

Grider, J., W.E. Thogmartin, E.H.C. Grant, R.F. Bernard, and R.E. Russell. 2022. Early treatment of white-nose syndrome is necessary to stop population decline. Journal of Applied Ecology 59(10): 2531-2541.

Grieneisen, L. 2011. Hibernacula microclimate and white-nose syndrome susceptibility in the little brown myotis (*Myotis lucifugus*). M.Sc. Thesis. Bucknell University, Lewisburg, PA.

Grieneisen, L.E., S.A. Brownlee-Bouboulis, J.S. Johnson, and D.M. Reeder. 2015. Sex and hibernaculum temperature predict survivorship in white-nose syndrome affected little brown myotis (*Myotis lucifugus*). *R Soc Open Sci.* 1 February 2015; 2 (2): 140470. https://doi.org/10.1098/rsos.140470.

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

Griffin, D.R. 1945. Travels of banded cave bats. Journal of Mammalogy 26:15-23.

Grindal, S.D., T.S. Collard, R.M. Brigham, and R.M.R. Barclay. 1992. The influence of precipitation on reproduction by *Myotis* bats in British Columbia. The American Midland Naturalist. 128:339-344.

Grindal, S.D., C.I. Stefan, and C. Godwin-Sheppard. 2011. Diversity, distribution, and relative abundance of bats in the oil sands regions of Northeastern Alberta. Northwestern Naturalist 92: 211-220.

Grindal, S. and M. Brigham. 1999. Impacts of forest harvesting on habitat use by foraging insectivorous bats at different spatial scales. Ecoscience 6: 25-34.

Grindal, S.D., J.L. Morissette, and R.M. Brigham. 1999. Concentration of bat activity in riparian habitats over an elevational gradient. Canadian Journal of Zoology 77: 972-977.

Gwich'in Language Centre and Gwich'in Social and Cultural Institute (GSCI). 2005. Teetl'it ts'at Gwichyah Gwich'in Ginjik Gwi'dinehtl'ee': Gwich'in Language Dictionary (Fort McPherson and Tsiigehtchic dialects). 5th Ed. Gwich'in Language Centre and Gwich'in Social and Cultural Institute, Teetl'it Zheh and Tsiigehtchic, NT. 276 pp.

Gwich'in Renewable Resources Board (GRRB), unpublished data. 2022. Results of ultrasound acoustic monitoring conducted 2019-2021 in the Gwich'in Settlement Area. Data provided by K. Cooper (Species at Risk Biologist). Unpublished data, June 2022. Gwich'in Renewable Resources Board, Inuvik, NT.

Gwich'in Renewable Resources Board (GRRB), unpublished data. 2026. Results of ultrasound acoustic monitoring conducted in 2025 for the project "Investigating Bat Prevalence in the Gwich'in Settlement Area." Data provided by A. Sallans (Species at Risk Biologist). Unpublished data, February 2026. Gwich'in Renewable Resources Board, Inuvik, NT.

Henderson, L.E. and H.G. Broders. 2008. Movements and resource selection of the northern long-eared myotis (*Myotis septentrionalis*) in a forest - agriculture landscape. Journal of Mammalogy 89:952-963.

Henderson, L., L. Farrow, and H. Broders. 2008. Intra-specific effects of forest loss on the distribution of the forest-dependent northern long-eared bat (*Myotis septentrionalis*). Biological Conservation 141: 1819-1828.

Hendricks, P. 2012. Winter records of bats in Montana. Northwestern Naturalist 93:154-162.

Hilty, S.L., A.R. Litt, B.A. Maxell, C.N. Gower, R.A. Garrott, and L. Hanauska-Brown. 2024. Characterizing diurnal roosts of male little brown myotis (*Myotis lucifugus*) during summer. Journal of Mammalogy 105: 652-666.

Hitchcock, H.B. 1965. Twenty-three years of bat banding in Ontario and Quebec. Canadian Field-Naturalist 79:4-14.

Hoff, S., C. Pendergast, L. Johnson, E. Olson, D. O'Dell, Z.R. Dowling, K.M. Gorman, C. Herzog, and W.C. Turner. 2024. Seasonal roost characteristics and fall behaviour of coastal populations of northern myotis (*Myotis septentrionalis*). Journal of Mammalogy 105(2): 277-288.

Hogburg, L.K., K.J. Patriquin, and R.M.R. Barclay. 2002. Use by bats of patches of residual trees in logged areas of the boreal forest. The American Midland Naturalist 148:282-288.

Holloway, G. and R. Barclay. 2000. Importance of prairie riparian zones to bats in southeastern Alberta. Ecoscience 7: 115-122.

Holroyd, S.L. 1993. Influences of some extrinsic and intrinsic factors on reproduction by big brown bats (*Eptesicus fuscus*) in southeastern Alberta. M.Sc. thesis, University of Calgary, Calgary, AB.

Holroyd, S., C. Lausen, S. Dulc, E. de Freitas, R. Crawford, J. O'Keefe, C. Boothe, J. Segers, and J. Reichard. 2023. Best management practices for the use of bat houses in US and Canada – with focus on summer habitat mitigation for little brown myotis, yuma myotis, and big brown bat. Wildlife Conservation Society Canada, produced in cooperation with US Fish and Wildlife Service and Canadian Wildlife Health Cooperative for the WNS Conservation and Recovery Working Group. Version (last updated): 20 Sept. 2023. https://doi.org/10.7944/P99K4BF5.

Hooton, L.A., A.A. Adams, A. Cameron, E.E. Fraser, L. Hale, S. Kingston, M.B. Fenton, L.P. McGuire, E.E. Stukenholtz, and C.M. Davy. 2023. Effects of bat white-nose syndrome on hibernation and swarming aggregations of bats in Ontario. Canadian Journal of Zoology 101(10): 886-895.

Horne, G. and D. Critchley. 2019. Nahanni National Park Reserve Report of Bat & Cave Monitoring - 2019. Prepared for Nahanni National Park Reserve, Parks Canada. 67 pp.

Hoyt, J.R., K.E. Langwig, J. Okoniewski, W.F. Frick, W.B. Stone, and A.M. Kilpatrick. 2015. Long-term persistence of *Pseudogymnoascus destructans*, the causative agent of white-note syndrome, in the absence of bats. Ecohealth 12: 330-333.

Hoyt, J.R., K.E. Langwig, J.P. White, H.M. Kaarakka, J.A. Redell, K.L. Parise, W.F. Frick, J.T. Foster, and A.M. Kilpatrick. 2019. Field trial of a probiotic bacteria to protect bats from white-nose syndrome. Scientific Reports 9(1): 9158.

Hoyt, J.R., A.M. Kilpatrick, and K.E. Langwig, 2021. Ecology and impacts of white-nose syndrome on bats. Nature Reviews Microbiology 19: 196–210.

Humphrey, S. and J. Cope. 1976. Population ecology of the little brown bat, *Myotis lucifugus*, in Indiana and north-central Kentucky. American Society Mammalogists Special Publication 4:1-81.

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

Hurtado, C., unpublished data. 2024. Results of ultrasound acoustic monitoring done in the Sahtú region in 2021 in collaboration with SRRB, RRCs, University of Alberta and GNWT-ECC. Data provided by C. Hurtado. Unpublished data, November 2024.

IUCN (International Union for Conservation of Nature). 2008. *Myotis septentrionalis*. The IUCN Red List of Threatened Species. Range Map [spatial data – shape file] Version 2025-2. Website: http://www.iucnredlist.org [Accessed October 2025].

IUCN (International Union for Conservation of Nature). 2021. *Myotis lucifugus*. The IUCN Red List of Threatened Species. Range Map [spatial data – shape file] Version 2025-2. Website: http://www.iucnredlist.org [Accessed October 2025].

International Union for the Conservation of Nature (IUCN). 2014. Guidelines for using the IUCN Red List categories and criteria. Version 11. Prepared by the Standards and Petitions Subcommittee. Website: http://www.amphibians.org/wp-content/uploads/2014/02/RedListGuidelines-v11.pdf [Accessed August 2016].

Jain, P., Q.E. Barber, S.W. Taylor, E. Whitman, D. Castellanos Acuna, Y. Boulanger, R.D. Chavardès, J. Chen, P. Englefield, M. Flannigan, M.P. Girardin, C.C. Hanes, J. Little, K. Morrison, R.S. Skakun, D.K. Thompson, X. Wang, and M.A. Parisien. 2024. Drivers and impacts of the record-breaking 2023 wildfire season in Canada. Nature Communications 15(1): 6764.

Jochum, K. pers. comm. 2025. Email exchange. National Parks Service, Alaska Regional Office.

Johnson, J.B., J.W. Edwards, and W.M. Ford. 2011. Nocturnal activity patterns of northern myotis (*Myotis septentrionalis*) during the maternity season in West Virginia (USA). Acta Chiropterologica 13:391-397.

Johnson, J.B., J.W. Edwards, W.M. Ford, and J.E. Gates. 2009. Roost tree selection by northern myotis (*Myotis septentionalis*) maternity colonies following prescribed fire in a central Appalachian Mountains hardwood forest. Forest Ecology and Management 258:233-242.

Johnson, J.B., W.M. Ford, and J.W. Edwards. 2012. Roost networks of northern myotis (*Myotis septentrionalis*) in a managed landscape. Forest Ecology and Management 266:223-231.

Johnson, C., D.J. Brown, C. Sanders, and C.W. Stihler. 2021. Long-term changes in occurrence, relative abundance, and reproductive fitness of bat species in relation to arrival of white-nose syndrome in West Virginia, USA. Ecology and Evolution 11(18): 12453-12467.

Jones, J.K., Jr., R.S. Hoffman, D.W. Rice, C. Jones, R.J. Baker, and M.D. Engstrom. 1992. Revised checklist of North American mammals north of Mexico, 1991. Occasional Papers, The Museum, Texas Tech University 146:1-23.

Jung, T., I. Thompson, R. Titman, and A. Applejohn. 1999. Habitat selection by forest bats in relation to mixed-wood stand types and structure in central Ontario. Journal of Wildlife Management 63: 1306-1319.

Jung T.S., C.L. Lausen, J.M. Talerico, and B.G. Slough. 2011. Opportunistic predation of a little brown bat (*Myotis lucifugus)* by a great horned owl (Bubo virginianus) in southern Yukon. Northwestern Naturalist 92(1): 69-72.

Jung, T.S. 2013. Estimating little brown bat (*Myotis lucifugus*) colony size in southern Yukon: a mark-recapture approach. Yukon Fish and Wildlife Branch Report TR-13-13. Whitehorse, Yukon, Canada.

Jung, T.S., K.M. Blejwas, C.L. Lausen, J.M. Wilson, and E. Olson. 2014. Concluding remarks: what do we need to know about bats in northwestern North America? Northwestern Naturalist, 95(3): 318-330.

Jung, T.S. 2020. Bats in the changing boreal forest: response to a megafire by endangered little brown bats (*Myotis lucifugus*). Écoscience 27(1): 59-70.

Kalen, N.J., M.S. Muthersbaugh, J.B. Johnson, A. Silvis, and W.M. Ford. 2022. Northern long-eared bats in the central Appalachians following white-nose syndrome: failed maternity colonies? Journal of the Southeastern Association of Fish and Wildlife Agencies 9: 159-167.

Karouna-Renier, N.K., C. White, C.R. Perkins, J.J. Schmerfeld, and D. Yates. 2014. Assessment of mitochondrial DNA damage in little brown bats (*Myotis lucifugus*) collected near a mercury-contaminated river. Ecotoxicology 23(8): 1419-1429.

Kaupas, L. 2015. Investigation of northern adaptations in tree-roosting bats in the South Slave [Research Summary Report]. Associated with research permit number WL500247. Wildlife Division, Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT.

Kaupas, L. and R. Barclay. 2015. Investigation of northern adaptations in tree-roosting bats in the South Slave Region (Research Summary Report]. Associated with research permit number WL500329. Wildlife Division, Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT.

Kaupas, L. 2016. Roosting behaviour and thermoregulation of the northern long-eared bat (*Myotis septentrionalis*) near the northern extent of its range. M.Sc. Thesis, University of Calgary, Calgary, Alberta. 100 pp.

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.

Keen, R. and H.B. Hitchcock. 1980. Survival and longevity of the little brown bat (*Myotis lucifugus*) in southeastern Ontario. Journal of Mammalogy 61: 1-7.

Kelly, C.A., J.W.M. Rudd, R.A. Bodaly, N.P. Roulet, V.L. St. Louis, A. Heyes, T.R. Moore, S. Schiff, R. Aravena, K.J. Scott, B. Dyck, R. Harris, B. Warner, and G. Edwards. 1997. Increases in fluxes of greenhouse gases and methyl mercury following flooding of an experimental reservoir. Environmental Science & Technology 31: 1334-1344.

Kelly, A. and K. Cox. 2015. Bat research and monitoring in the South Slave, 17 March 2014 – 17 March 2015. Associated with Wildlife Research Permit WL500225. Environment and Natural Resources, Government of the Northwest Territories, Fort Smith, NT.

Kelly, A. unpubl. data. 2013. Temperature and 100% relative humidity readings for the South Slave Hibernaculum (November through July 2013). Environment and Natural Resources, Government of the Northwest Territories, Fort Smith, NT.

Khayat R.O.S., R.A. Grant, H. Ryan, L.M. Melling, G. Dougill, D.R. Killick and K.J. Shaw. 2020 Investigating cat predation as the cause of bat wing tears using forensic DNA analysis. Ecology and Evolution: 10(15):8368-8378. doi: 10.1002/ece3.6544. PMID: 32788986; PMCID: PMC7417221.

Kilpatrick, M. 2013. Transmission of *Geomyces destructans* between bats and the environment. International Bat Research Conference, San Jose, Costa Rica, 11-15 August.

Krochmal, A.R. and D.W. Sparks. 2007. Timing of birth and estimation of age of juvenile Myotis septentrionalis and Myotis lucifugus in west-central Indiana. Journal of Mammalogy 88(3): 649-656.

Krusic, R.A., M. Yamasaki, C.D. Neefus, and P.J. Pekins. 1996. Bat habitat use in White Mountain National Forest. The Journal of Wildlife Management 60: 625-631.

Koivula, M. T. Cobb, A. Déchêne, J. Jacobs, and J. Spence. 2006. Responses of two Sericoda Kirby, 1837 (Coleoptera: Carabidae) species to forest harvesting, wildfire, and burn severity. Entomologica Fennica 17: 315-324.

Krynak, T.J. 2010. Bat habitat use and roost tree selection for northern long-eared myotis (*Myotis septentrionalis*) in north-central Ohio. M.Sc. Thesis, John Carroll University, Cleveland, Ohio, USA.

Kuerschner, M. 2024. Mercury exposure, fuel stores and torpor use in silver-haired bats. M.Sc. Thesis, University of Western Ontario, London, Ontario. 69 pp.

Kunz, T.H. and L.F. Lumsden. 2003. Ecology of cavity and foliage roosting bats. Pp. 49-60 *In* Bat Ecology, T.H. Kunz and M.B. Fenton (eds). The University of Chicago Press, Chicago, IL.

Kunz, T.H. and J.D. Reichard. 2010. Status review of the little brown myotis (*Myotis lucifigus*) and determination that immediate listing under the *Endangered Species Act* is scientifically and legally warranted. Report in collaboration with: Friends of Blackwater Canyon, Wildlife Advocacy Project, Bat Conservation International, Center for Biological Diversity, and Meyer Glitzenstein & Crystal.

Kurta, A., G.P. Bell, K.A. Nagy, and T.H. Kunz. 1989. Energetics of pregnancy and lactation in free-ranging little brown bats (*Myotis lucifugus*). Physiological Zoology 62:804-818.

Kurta, A., T.H. Kunz, and K.A. Nagy. 1990. Energetics and water flux of free-ranging big brown bats (*Eptesicus fuscus*) during pregnancy and lactation. Journal of Mammalogy 71: 59-65

Lacki, M.J., L.E. Dodd, N.S. Skowronski, M.B. Dickinson, and L.K. Rieske. 2017. Relationships among burn severity, forest canopy structure and bat activity from spring burns in oak-hickory forests. International Journal of Wildland Fire 26(11): 963-972.

Langwig, K.E., W.F. Frick, J.T. Bried, A.C. Hicks, T.H. Kunz, and A.M. Kilpatrick. 2012. Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome. Ecology Letters 15:1050-1057.

Langwig K.E., W.F. Frick, R. Reynolds, K.L. Parise, K.P. Drees, J.R. Hoyt, T.L. Cheng, T.H. Kunz, J.T. Foster, and A.M. Kilpatrick. 2015. Host and pathogen ecology drive the seasonal dynamics of a fungal disease, white-nose syndrome. Proceedings of the Royal Society: B 282: 20142335.

Langwig, K.E., J.R. Hoyt, K.L. Parise, W.F. Frick, J.T. Foster and A.M. Kilpatrick. 2017. Resistance in persisting bat populations after white-nose syndrome invasion. *Philos Trans R Soc Lond B Biol Sci* 19 January 2017; 372 (1712): 20160044. https://doi.org/10.1098/rstb.2016.0044.

Larter, N.C., C.R. Macdonld, D.Muir, B.T. Elkin and X. Wang. 2015. Multi-elements, radionuclides and persistent organics in tissues of mountain goats in Northwest Territories. Biennial Symposium for the Northern Wild Sheep and Goat Council 19: 98-107; 2014.

Lausen, C.L. 2005. First record of hosts for tick *Carios kelleyi* (Acari: Ixodida: Argasidae) in Canada and Montana. Journal of Medical Entomology 42: 497-501.

Lausen, C.L. 2006. Bat survey of Nahanni National Park Reserve and surrounding areas, Northwest Territories [Report]. Prepared for Parks Canada, Nahanni National Park Reserve, Fort Simpson, NT and Canadian Parks and Wilderness Society, Yellowknife, NT. Kaslo, BC. vi + 39 pp.

Lausen, C.L. 2011. Late summer survey of bat hibernacula and bat diversity in South Slave Region, Northwest Territories and Wood Buffalo National Park, Alberta [Report]. Birchdale Ecological Ltd. Kaslo, BC. 34 pp.

Lausen, C.L. and R.M.R. Barclay. 2006. Winter bat activity in the Canadian prairies. Canadian Journal of Zoology 84: 1079-1086.

Lausen, C.L., J. Waithaka, and D.P. Tate. 2014. Bats of Nahanni National Park Reserve and surrounding areas, Northwest Territories. Northwestern Naturalist 95:186-196.

Lausen, C.L., J.M. Talerico, L.A. Randall, and T.S. Jung. In prep. Morphometrics and plasticity in echolocation calls of little brown bats (*Myotis lucifugus*) at the northern edge of their range.

Lausen, C.L., T.S. Jung, and J.M. Talerico. 2008. Range extension of the northern long-eared bat (*Myotis septentrionalis*) in the Yukon. Northwestern Naturalist 89(2): 115-117.

Lausen, C.L., D.W. Nagorsen, R.M. Brigham, and J. Hobbs. 2022. Bats of British Columbia. 2nd ed. Royal BC Museum, Victoria, British Columbia, Canada.

Laursen, S.E. 2025. Climatic variation predicts spatial response in body size but not sexual size dimorphism in little brown myotis (*Myotis lucifugus*). M.Sc. Thesis, Carleton University, Ottawa, Ontario. 81 pp.

Lauzon, A., S.M. Burns, D.J.H. Sleep, E.F. Baerwald, and R.M. Brigham. 2025. Long-term effects of forest harvesting on habitat use by temperate insectivorous bats. Forest Ecology and Management 588: 122760.

Legros, J. 2023. Habitat selection of temperate bats at different temporal and spatial scales. M.Sc. Thesis, McGill University, Montreal, Québec.

Legros, J., L.P McGuire, K.H. Elliott, and A. Simard. 2024. The relative influence of landscape features on maternity roost and hibernaculum selection in temperate bats. Canadian Journal of Zoology 102(7): 600-613.

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 and Affiliated Societies 506.

Lemieux-Labonté, V., A. Simard, C.K. Willis, and F.J. Lapointe. 2017. Enrichment of beneficial bacteria in the skin microbiota of bats persisting with white-nose syndrome. Microbiome 5(1): 115.

Leung, M.C-Y., D.G. Reid, and W.D. Halliday. 2022. Sun hats for bat boxes: mitigating the risk of overheating at northern latitudes. Northwestern Naturalist 103(3): 226-235.

Lewis, M.A., G.G. Turner, M.R. Scafini, J.S. Johnson. 2022. Seasonal roost selection and activity of a remnant population of northern myotis in Pennsylvania. PLoS ONE 17(7): e0270478.

Lilley, T.M., J.S. Johnson, L. Ruokolainen, E.J. Rogers, C.A. Wilson, S.M. Schell, K.A. Field, and D.M. Reeder. 2016. White-nose syndrome survivors do not exhibit frequent arousals associated with *Pseudogymnoascus destructans* infection. Frontiers in Zoology 13:12.

Lilley, T.M., I.W. Wilson, K.A. Field, D.M. Reeder, M.E. Vodzak, G.G. Turner, A. Kurta, A.S. Blomberg, S. Hoff, C.J. Herzog, and B.J. Sewall. 2020. Genome-wide changes in genetic diversity in a population of *Myotis lucifugus* affected by white-nose syndrome. G3: Genes, Genomes, Genetics, 10(6): 2007-2020.

Lindenmayer, D.B., W. Blanchard, L. McBurney, D. Blair, S. Banks, G.E. Likens, J.F. Franklin, W.F. Laurance, J.A.R. Stein, and P. Gibbons. 2012. Interacting factors driving a major loss of large trees with cavities in a forest ecosystem. PLoS ONE 7(10): e41864.

Lindner, D.L., A. Gargas, J.M. Lorch, M.T. Banik, J. Glaeser, T.H. Kunz, and D.S. Blehert. 2011. DNA-based detection of the fungal pathogen Geomyces destructans in soils from bat hibernacula. Mycologia 103(2): 241-246.

Little, M.E., N.M. Burgess, H. Broders, and L.M. Campbell. 2015. Distribution of mercury in archived fur from little brown bats across Atlantic Canada. Environmental Pollution 207: 52-28.

Lippert, H.D. 2001. The relationship of bat activity to habitat type and structure retention in managed, boreal forests of west-central Alberta. M.Sc. Thesis, University of Alberta, Edmonton, Alberta.

Loeb, S.C. and J.M. O'Keefe. 2006. Habitat use by forest bats in South Carolina in relation to local, stand, and landscape characteristics. Journal of Wildlife Management 70:1210-1218.

Loeb, S.C. and J.M. O'Keefe. 2011. Bats and gaps: the role of early successional patches in the roosting and foraging ecology of bats. Managing Forest Ecosystems 21: 167-189.

Lorch, J.M., C.U. Meteyer, M.J. Behr, J.G. Boyles, P.M. Cryan, A.C. Hicks, A.E. Ballmann, J.T.H. Coleman, D.N. Redell, D.M. Reeder, and D.S. Blehert. 2011. Experimental infection of bats with *Geomyces desctructans* causes white-nose syndrome. Nature 480: 376-378.

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(4): e00148-16.

Lorch, J.M., L.K. Muller, R.E. Russell, M. O'Connor, D.L. Lindner, D.S. Blehert. 2013. Distribution and environmental persistence of the causative agent of white-nose syndrome, *Geomyces destructans*, in bat hibernacula of the Eastern United States. Applied and Environmental Microbiology 79:1293-1301.

Low, E.B. 2022. The effects of the Kenow wildfire on the bat community in Waterton Lakes National Park, Alberta. M.Sc. Thesis, University of Calgary, Calgary, Alberta. 185 pp.

Low, E.B., K.R.N. Florko, H.K. Mahoney, and R.M.R. Barclay. 2024. Effects of a severe wildfire on a bat community in the Canadian Rocky Mountains. Forest Ecology and Management 563: 121983.

Lowe, A.J. 2012. Swarming behaviour and fall roost-use of little brown (*Myotis lucifugus*), and northern long-eared bats (*Myotis septentrionalis*) in Nova Scotia, Canada. M.Sc. Thesis, St. Mary's University, Halifax, Nova Scotia.

Ma, S., A. Concilio, B. Oakley, M. North, and J. Chen. 2010. Spatial variability in microclimate in a mixed-conifer forest before and after thinning and burning treatments 259: 904-915.

Mackenzie Valley Land and Water Board (MVLWB). 2026. Public Registry. Website: https://mvlwb.com/registry [Accessed January 2026].

Malison, R.L. and C.V. Baxter. 2010. The fire pulse: wildfire stimulates flux of aquatic prey to terrestrial habitats driving increases in riparian consumers. Canadian Journal of Fisheries and Aquatic Sciences 67: 570-579.

Mallinger, E.C., K.R. Goodwin, A. Kirschbaum, Y. Shen, E.H. Gillam, and E.R. Olson. 2023. Species-specific responses to white-nose syndrome in the Great Lakes region. Ecology and Evolution 13(7): p.e10267.

Martin-Bideguren, G. A. López-Baucells, X. Puig-Montserrat, M. Mas, X. Porres, and C. Flaquer. 2019. Bat boxes and climate change: testing the risk of over-heating in the Mediterranean region. Biodiversity and Conservation 28: 21-35.

McAlpine, D.F. 1983. Status and conservation of solution caves in New Brunswick. The New Brunswick Museum, St. John, NB.

McManus, J.J. 1974. Activity and thermal preference of the little brown bat, *Myotis lucifugus*, during hibernation. Journal of Mammalogy 55:844-846.

Menzel, M.A., S.F. Owen, W.M. Ford, J.W. Edwards, P.B. Wood, B.R. Chapman, and K.V. Miller. 2002. Roost tree selection by northern long-eared bat (*Myotis septentrionalis*) maternity colonies in an industrial forest of the central Appalachian mountains. Forest Ecology and Management 155: 1-3.

Messenger, S., C. Rupprecht, and J. Smith. 2003. Bats, emerging virus infections, and the rabies paradigm. Pp. 622-657 *in* T. Kunz and F. Fenton (Eds.). Bat Ecology. University of Chicago Press, Chicago, Illinois. 779 pp.

Meteyer, C.U., M. Valent, J. Kashmer, E.L. Buckles, J.M. Lorch, D.S. Blehert, A. Lollar, D. Berndt, E. Wheeler, C.L. White, and A.E. Ballman. 2011. Recovery of little brown bats (*Myotis lucifugus*) from natural infection with *Geomyces destructans*, white-nose syndrome. Journal of Wildlife Diseases 47: 618-626.

Meyer, G.A., Senulis, J.A., and J.A., Reinartz. 2016. Effects of temperature and availability of insect prey on bat emergence from hibernation in spring. Journal of Mammalogy web access only DOI: 10. 1093/jmammal/gyw126.

Micalizzi, E.W., S.A. Forshner, E.B. Low, B. Johnston, S.A. Skarsgard, and R.M.R. Barclay. 2023. Female little brown bats require both building and natural roosts in a mountainous environment with short summers. Ecosphere 14(12): e4731.

Moosman, P.R. Jr., J.P. Veilleux, G.W. Pelton, and H.H. Thomas. 2013. Changes in capture rates in a community of bats in New Hampshire during the progression of white-nose syndrome. Northeastern Naturalist 20:552-558.

Nadine-Davis, S.A., W. Huang, J. Armstrong, G.A. Casey, C. Bahloul, N. Tordo, and A.I. Wandeler. 2001. Antigenic and genetic divergence of rabies viruses from bat species indigenous to Canada. Virus Research 74:139-156.

Nagorsen, D.W. and R. M. Brigham. 1993. Bats of British Columbia. UBC Press, Vancouver, BC. 164 pp.

Nagorsen, D.W., A.A. Bryant, D. Kerridge, G. Roberts, A. Roberts, and M.J. Sarell. 1993. Winter bat records for British Columbia. Northwestern Naturalist 74:61-66.

National Forestry Database. 2023. Forest fires. http://nfdp.ccfm.org/en/data/fires.php. [Accessed October 2025].

NatureServe. 2014. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Website: http://explorer.natureserve.org [Accessed January 2015].

Neilson, A.L. and M.B. Fenton. 1994. Responses of little brown myotis to exclusion and to bat houses. Wildlife Society Bulletin 22: 8-14.

Nelson, J.J. and E.H. Gillam. 2017. Selection of foraging habitat by female little brown bats (*Myotis lucifugus*). Journal of Mammalogy 98(1): 222-231.

Neubaum, D.J. 2018. Unsuspected retreats: autumn transitional roosts and presumed winter hibernacula of little brown myotis in Colorado. Journal of Mammalogy 99(6): 1294-1306.

Norquay, K.J.O. and C.K.R. Willis. 2014. Hibernation phenology of *Myotis lucifugus*. Journal of Zoology 294:85-92.

Norquay, K.J.O., F. Martinez-Nuñez, J.E. Dubois, K.M. Monson, and C.K.R. Willis. 2013. Long-distance movements of little brown bats (*Myotis lucifugus*). Journal of Mammalogy 94: 506-515.

North Slave Métis Alliance (NSMA), unpublished data. 2026. Results of bat monitoring program at Old Fort Rae including 2024 acoustic monitoring and 2025 field capture survey. Data provided by Orna Phelan (Wildlife Biologist). Unpublished data, February 2026. North Slave Métis Alliance, Yellowknife, NT.

Northwest Territories Biodiversity Monitoring Program (NTBMP), unpublished data. 2025. Results of ultrasound acoustic monitoring from: Norman Wells Project, 2022-2023, Fort Smith Project, 2022-2023, and Mackenzie Valley Winter Road Project, 2023-

2024. Data provided in December 2025 by L. Cowan (Wildlife Biologist, Biodiversity), Government of the Northwest Territories, Yellowknife, NT.

Northwest Territories Geoscience Office. 2013. Northern mineral showings database. Government of the Northwest Territories, Yellowknife, NT. Website: http://www.nwtgeoscience.ca/services/geological_library.html [Accessed August 2016].

NWT News/North Online. 2014. Setting a baseline for South Slave bats. Website: www.nnsl.com/frames/newspapers/2014-08/aug18_14bat.html# [Accessed November 2015].

NWT Species at Risk. 2026. 2025-26 Species Conservation and Recovery Fund (SCARF) project summaries. Investigating population structure and connectivity of little brown bats across the Northwest Territories, J. Reimer and L. Kaupas. Website: https://www.nwtspeciesatrisk.ca/en/2025-26-scarf-project-summaries

Oedin M., F. Brescia, A. Millon, B.P. Murphy, P. Palmas, J.C. Woinarski, and E. Vidal. 2021. Cats Felis catus as a threat to bats worldwide: a review of the evidence. Mammal Review 51(3): 323-37.

O'Farrrell, M.J. and E.H. Studier. 1973. Reproduction, growth, and development in *Myotis thysanodes* and *M. lucifugus* (Chiroptera: Vespertilionidae). Ecology 54(1): 18-30.

Olson, C.R. 2011. The roosting behaviour of little brown bats (*Myotis lucifugus*) and northern long-eared bats (*Myotis septentrionalis*) in the boreal forest of northern Alberta. M.Sc. Thesis, University of Calgary, Calgary, Alberta. 135 pp.

Olson, C.R., D.P. Hobson, and M.J. Pybus. 2011. Changes in population size of bats at the hibernaculum in Alberta, Canada, in relation to cave disturbance and access restrictions. Northwestern Naturalist 92:224-230.

Olson, C. pers. comm. 2026. Email exchange. January 2026. Alberta Bat Program, Wildlife Conservation Society Canada, Alberta, Canada.

Olson, C.R. and R.M.R. Barclay. 2013. Concurrent changes in group size and roost use by reproductive female little brown bats (*Myotis lucifugus*). Canadian Journal of Zoology 91(3): 149-155.

O'Shea, T.J., L.E. Ellison and T.R. Stanley. 2011. Adult survival and population growth rate in Colorado big brown bats (*Eptesicus fuscus*). Journal of Mammalogy 92:433-443.

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

Pacifici, M., L. Santini, M. Di Marco, D. Baisero, L. Francucci, G.G. Marasini, P. Visconti, and C. Rondinini. 2013. Generation length for mammals. Nature Conservation 5: 89-94.

Park, A. and H. Broders. 2012. Distribution and roost selection of bats on Newfoundland. Northeastern Naturalist 19: 165-176.

Parks Canada. 2024. Nahanni National Park Reserve NABat Data Analysis 2021-2023. 5 pp.

Parks Canada, unpublished data. 2025. Results of genetic analysis of bat samples collected in Nahanni National Park Reserve. Unpublished data provided in December 2025 by C. Murchison, Ecologist Team Leader, Nahanni National Park Reserve, Parks Canada, Government of Canada, Fort Simpson, NT.

Pauli, B.P., P.A. Zollner, G.S. Haulton, G. Shao, and G. Shao. 2015. The simulated effects of timber harvest on suitable habitat for Indiana and northern long-eared bats. Ecosphere 6(4): 1-24.

Patriquin, K.J. and R.M.R. Barclay. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. Journal of Applied Ecology 40:646–657.

Patriquin, K.J, M.L. Leonard, H.G. Broders, W.M. Ford, E.R. Britzke, and A. Silvis. 2016. Weather as a proximate explanation for fission-fusion dynamics in female northern long-eared bats. Animal Behaviour 122:47-57.

Pearce, R.D. and T.J. O'Shea. 2007. Ectoparasites in an urban population of big brown bats (*Eptesticus fuscus*) in Colorado. Ectoparasitology 93:518-530.

Pettit, J.L. and J.M. Keefe. 2017. Impacts of white-nose syndrome observed during long-term monitoring of a midwestern bat community. Journal of Fish and Wildlife Management 8(1): 69-78.

Perry, R.W. 2013. A review of factors affecting cave climates for hibernating bats in temperate North America Environmental Reviews 21:28–39.

Powers, K.E., R.J. Reynolds, W. Orndorff, W.M. Ford and C.S. Hobson. 2015. Post-white-nose syndrome trends in Virginia's cave bats, 2008–2013. Journal of Ecology and the Natural Environment, 7(4), pp.113-123.

Psyllakis, J.M. and R.M. Brigham. 2006. Characteristics of diurnal roosts used by female *Myotis* bats in sub-boreal forests. Forest Ecology and Management 223: 93-102.

Puechmaille, S.J., G. Wibbelt, V. Korn, H. Fuller, F. Forget, K. Mühldorfer, A. Kurth, W. Bogdanowicz, C. Borel, T. Bosch, T. Cherezy, M. Drebet, T. Görföl, A-J. Haarsma, F. Herhaus, G. Hallart, M. Hammer, C. Jungmann, Y. Le Bris, L. Lutsar, M. Masing, B. Mulkens, K. Passior, M. Starrach, A. Wojtaszewski, U. Zöphel, and E.C. Teeling. 2011.

Pan-European distribution of white-nose syndrome fungus (*Geomyces destructans*) not associated with mass mortality. PLoSONE 6: e19167. doi: 10.1371/journal/pone.0019167.

Randall, J. and H.G. Broders. 2014. Identification and characterization of swarming sites used by bats in Nova Scotia, Canada. Acta Chiropterologica 16:109-116.

Randall, L.A., T.S. Jung, and R.M.R. Barclay. 2014. Roost-site selection and movements of little brown myotis (*Myotis lucifugus*) in southwestern Yukon. Northwestern Naturalist 95:312-317.

Randall, L., R. Barclay, M. Reid, and T. Jung. 2011. Recent infestation of forest stands by spruce beetles do not predict habitat use by little brown bats (*Myotis lucifugus*) in southwestern Yukon, Canada. Forest Ecology and Management 261: 1950-1956.

Ratcliffe, J.M. and J.W. Dawson. 2003. Behavioural flexibility: the little brown bat, *Myotis lucifugus*, and the northern long-eared bat, *M. septentrionalis,* both glean and hawk prey. Animal Behaviour 66(5): 847-856.

Regnery, B., D. Couvet, L. Kubarek, J.F. Julien, and C. Kerbiriou. 2013. Tree microhabitats as indicators of bird and bat communities in Mediterranean forests. Ecological Indicators 34: 221-230.

Reimer, J.P. 2013. Nocturnality under the midnight sun: behavioural adaptations of the little brown bat (*Myotis lucifugus*) at 60°N latitude. M.Sc. Thesis, University of Calgary, Calgary, AB. 108 pp.

Reimer, J.P. unpubl. data. 2012. Radiotelemetry locations of *Myotis lucifugus* tagged at the Thebacha maternity colony, Northwest Territories. University of Calgary, Calgary, AB.

Reimer, J., unpubl. data. 2013. Acoustic monitoring and morphometric measurements of *Eptesicus fuscus, M. lucifugus* and *M. septentrionalis* in the South Slave region of the NWT. University of Calgary, Calgary, AB.

Reimer, J. unpubl. data. 2014. Capture surveys and morphometric measurements of *Myotis lucifugus* in Katmai National Park and Preserve, Alaska. Taiga Wildlife Research, Emigrant Gap, CA.

Reimer, J.P. and L. Kaupas. 2013. South Slave region bat research summary 2013 [Report]. Prepared for Environment and Natural Resources, Government of the Northwest Territories, Fort Smith, NT. University of Calgary, Calgary, AB. 8 pp.

Reimer, J.P., C.L. Lausen, R.M.R. Barclay, S. Irwin, and M.K. Vassal. 2014. Bat activity and use of hibernacula in Wood Buffalo National Park, Alberta. Northwestern Naturalist 95:277-288.

Reimer, J.R. and R.M.R. Barclay. 2024. Seasonal phenology of the little brown bat (*Myotis lucifugus*) at 60°N. Ecosphere 15(2): e4778.

Ruess, R.W., L.M. Winton, and G.C. Adams. 2021. Widespread mortality of trembling aspen (*Populus tremuloides*) throughout interior Alaskan boreal forests resulting from a novel canker disease. PLoS ONE 16(4): e0250078.

Rydell, J. 1991. Occurrence of bats in northernmost Sweden (656N) and their feeding ecology in summer. Journal of Zoology, London 227: 517-529.

Rydell, J., A. Bushby, C.C. Cosgrove, and P.A. Racey. 1994. Habitat use by bats along rivers in northeast Scotland. Folia Zoologica 43: 417-424.

Rysgaard, G.N. 1942. A study of the cave bats of Minnesota with special reference to the large brown bat, *Eptesicus fuscus fuscus* (Beauvois). American Midland Naturalist 28:245-267.

Sahtú Renewable Resources Board (SRRB) and Species at Risk Secretariat (SARS). 2013. Report of the Sahtú Species at Risk Terminology Workshop. Website: http://www.nwtspeciesatrisk.ca/sites/default/files/final_report_of_sar_sahtu_workshop_13-11-01.pdf [Accessed December 2015].

Sallans, A., pers. comm. 2026. Email correspondence with M. Grabke on the final draft of the Species Status Report for Little Brown Myotis and Northern Myotis in the NWT. May 2026.

Sasse, D. and P. Pekins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Pp. 91-101 *in* R. Barclay and M. Brigham (Eds.). Bats and Forests Symposium, October 19-21, 1995, Victoria, BC. Working Paper 23/1996. British Columbia Ministry of Forests, Victoria, BC. 292 pp.

Scesny, A.A. 2006. Detection of fire by eastern red bats (*Lasiurus borealis*): arousal from torpor. M.Sc. Thesis, Missouri State University, Springfield, Missouri. 26 pp.

Schorr, R.A. and J.L. Siemers. 2021. Population dynamics at summer roosts: Apparent survival, fidelity, abundance, and the influence of winter conditions. Ecology and Evolution 11: 7427-7438.

Schowalter, D.B. 1980. Swarming, reproduction, and early hibernation of *Myotis lucifugus* and *M. volans* in Alberta, Canada. Journal of Mammalogy 61:350-354.

Scotter, G.W., N.M. Simmons, H.L. Simmons, and S.C. Zolted. 1971. Ecology of the South Nahanni and Flat River areas. Submitted to the National and Historic Parks Branch. Canadian Wildlife Service, Edmonton, AB. 186 pp.

Secord, A.L., K.A. Patnode, C. Carter, E. Redman, D.J. Gefell, A.R. Major, and D.W. Sparks. 2015. Contaminants of emerging concern in bats from the Northeastern United States. Archives of Environmental Contamination and Toxicology 69: 411-421.

Segers, J., S. McBurney, M. Jones, and D. Joly. 2025. The Canadian Wildlife Health Cooperative Annual National Bat Health Report – 2025. Canadian Wildlife Health Cooperative, Saskatoon, Saskatchewan.

Shelley, V., S. Kaiser, E. Shelley, T. Williams, M. Kramer, K. Haman, K. Keel, and H.A. Barton. 2011. Evaluation of strategies for the decontamination of equipment for *Geomyces destructans*, the causative agent of white-nose syndrome (WNS). Journal of Cave and Karst Studies 75: 1–10.

Sherwin, H.A., W.I. Montgomery, and M.G. Lundy. 2012. The impact and implications of climate change for bats. Mammal Review, doi: 10.1111/j.1365-2907.2012.0

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.

Silvis, A., W.M. Ford, and E.R. Britzke. 2015. Effects of hierarchical roost removal on northern long-eared bat (*Myotis septentrionalis*) maternity colonies. PLoS ONE 10(1): e0116356.

Slough, B.G. and T.S. Jung. 2008. Observations on the natural history of bats in the Yukon. Northern Review 29: 127-150.

Slough, B.G. 2009. Behavioural thermoregulation by a maternity colony of little brown bats in the Yukon. Northwestern Naturalist 90(1): 47-51.

Slough, B.G., T.S. Jung, and C.L. Lausen. 2014. Acoustic survey reveals hoary bat (*Lasiurus cinereus*) and long-legged myotis (*Myotis volans*) in Yukon. Northwestern Naturalist 95:176-185.

Slough, B.G. and T.S. Jung. 2020. Little brown bats utilize multiple maternity roosts within foraging areas: implications for identifying summer habitat. Journal of Fish and Wildlife Management 11(1): 311-320.

Snider, E.A., P.M. Cryan, K.R. Wilson. 2013. Roost selection by western long-eared myotis (*Myotis evotis*) in burned and unburned piñon-juniper woodlands of southwestern Colorado. Journal of Mammalogy 94(3): 640-649.

Snively, M.L., G.W. Pendleton, K.S. Christie, and K.M. Blejwas. 2021. Little brown myotis activity patterns in south-Central Alaska. Northwestern Naturalist 102(3): 216-231.

Solari, S. 2018. Myotis septentrionalis. The IUCN Red List of Threatened Species 2018: e.T14201A22064312.https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T14201A22064312.en. Accessed on 06 November 2025.

Solari, S. 2021. *Myotis lucifugus* (amended version of 2018 assessment). The IUCN Red List of Threatened Species 2021: e.T14176A208031565. https://dx.doi.org/10.2305/IUCN.UK.2021- 3.RLTS.T14176A208031565.en. Accessed on 06 November 2025.

South Slave Divisional Education Council. 2012. Dëne Dédlıné Yatıé ɂerehtł'íscho Denínu Kuę́ Yatıé – Chipewyan Dictionary. South Slave Divisional Education Council, Fort Smith, NT. 369 pp. Website: http://www.ssdec.nt.ca/ablang/ablanguage/chiptionary/Chipewyan%20Dictionary.pdf [Accessed July 2016].

South Slave Divisional Education Council. 2014. Dëné Sųłıné Yatıé ɂerehtł'ís Łuskëlk'e T'ıné Yatıé – Chipewyan Dictionary. South Slave Divisional Education Council, Fort Smith, NT. 487 pp. Website: http://www.ssdec.nt.ca/ablang/ablanguage/lkchipdictionary/Chipewyan_Dictionary-Linked/Chipewyan_Dictionary.pdf [Accessed July 2016].

South Slave Divisional Educatıon Council. 2009. South Slavey Topical Dictionary Kátł'odehche Dialect. South Slave Divisional Education Council, Fort Smith, NT. 203 pp. Website: http://www.ssdec.nt.ca/Dictionary/dictionary.pdf [Accessed July 2016].

Soya, A.J., N.M. Tchevbakova, N.H.F. French, M.D. Flanigan, H.H. Shugart, B.J. Stocks, A.I. Sukhinin, E.I. Parfenova, F.S. Chapin III, and P.W. Stackhouse Jr. 2007. Climate-induced boreal forest change: predictions versus current observations. Global and Planetary Change 56: 274-296.

Speakman, J.R. and A. Rowland. 1999. Preparing for inactivity: how insectivorous bats deposit a fat store for hibernation. Proceedings of the Nutrition Society 58: 123-132.

Speakman, J.R. and D.W. Thomas. 2003. Physiological ecology and energetics of bats. Pp. 430-492 *in* T.H. Kunz and M.B. Fenton (Eds.). Bat Ecology. University of Chicago Press, Chicago, IL.

Speakman, J.R., J. Rydell, P.I. Webb, J.P. Hayes, G.C. Hays, I.A.R. Hulbert, and R.M. McDevitt. 2000. Activity patterns of insectivorous bats and birds in northern Scandinavia (69^{0}N), during continuous mid-summer daylight. Oikos 88: 75-86.

Speakman, J.R., P.I. Webb and P.A. Racey. 1991. Effects of disturbance on the energy expenditure of hibernating bats. Journal of Applied Ecology 28: 1087-1104.

Species at Risk Committee (SARC). 2024. Detailed instructions for the preparation of a SARC status report: scientific knowledge component. Species at Risk Committee, Yellowknife, NT. Website: http://www.nwtspeciesatrisk.ca/media/6833/download?inline [Accessed October 2025].

Species at Risk Committee (SARC). 2017. Species Status Report for Big brown bat, Little Brown Myotis, Northern Myotis, Long-eared myotis, and Long-legged myotis (*Eptesicus fuscus, Myotis lucifugus, Myotis septentrionalis, Myotis evotis, and Myotis volans*) in the Northwest Territories. Species at Risk Committee, Yellowknife, NT.

Species at Risk Public Registry. 2015. Bats and white-nose syndrome in Canada. Government of Canada. Website: http://www.registrelep-sararegistry.gc.ca/default.asp?lang=En&n=073DC653-1 [Accessed November 2015].

Spence, C. J.M. Galloway, N. Hedstrom, S.V. Kokelj, S.A. Kokelj, P. Muise, B.W. Newton, R.T. Patterson, M.F.J. Pisaric, and G.T. Swindles. 2025. Process synchrony a key control of resilience in a subarctic freshwater system. Earth's Future 13: e2024EF005518.

Sunga, J.S., J. Humber, B. Rodrigues, L. McGuire, and H. Broders. 2021. Long-distance movement over a period of days by a female *Myotis lucifugus* in Newfoundland, Canada. Northeastern Naturalist 28(2): N24.

Sunga, J.S., Q.M.R. Webber, J. Humber, B. Rodrigues, and H.G. Broders. 2022. Roost fidelity partially explains maternity roosting association patterns in *Myotis lucifugus*. Animal Behaviour 194: 67-78.

Sunga, J.S. J. Humber, and H. Broders. 2024. Changes in roosting decisions and group structure following parturition in little brown myotis (*Myotis lucifugus)*. Scientific Reports 14: 22810.

Syaripuddin, K., A. Kumar, K.W. Sing, M.R.A. Halim, M.N. Nursyereen, and J.J. Wilson. 2014. Mercury accumulation in bats near hydroelectric reservoirs in Peninsular Malaysia. Ecotoxicology 23: 1164-1171.

Talerico, J. 2008. The behaviour, diet and morphology of little brown bats (*Myotis lucifugus*) near the northern extent of its range in Yukon, Canada. M.Sc. Thesis, University of Calgary, Calgary, AB. 104 pp.

Taylor, L.R. 1963. Analysis of the effect of temperature on insects in flight. Journal of Animal Ecology 32: 99-117.

Thomas, D.W. 1993. Bats, mines, and politics. Bats 2:10-1.

Thomas, D.W. 1995. Hibernating bats are sensitive to nontactile human disturbance. Journal of Mammalogy 76:940-946

Thomas, D.W., M. Dorais, and J. Bergeron. 1990. Winter energy budgets and cost of arousals for hibernating little brown bats, *Myotis lucifugus*. Journal of Mammalogy 71:475-479.

Thomas, D.W., M.B. Fenton, and R.M.R. Barclay. 1979. Social behavior of the little brown bat, *Myotis lucifugus*. Behavioral Ecology and Sociobiology 6:129-136.

Thomas, J.P. and T.S. Jung. 2019. Life in a northern town: rural villages in the boreal forest are islands of habitat for an endangered bat. Ecosphere 10(1): e02563.

Thomas, J.P., P.M. Kukka, J.E. Benjamin, R.M.R. Barclay, C.J. Johnson, F.K.A. Schmiegelow, and T.S. Jung. 2021. Foraging habitat drives the distribution of an endangered bat in an urbanizing boreal landscape. Ecosphere 12(3): e03457.

Thorne, T.J., E. Matczak, M. Donnelly, M.C. Franke, and K.C.R. Kerr. 2021. Occurrence of a forest-dwelling bat, northern myotis (*Myotis septentrionalis*), within Canada's largest conurbation. Journal of Urban Ecology 7(1): juab029.

Timpone, J.C., J.G. Boyles, K.L. Murray, D.P. Aubrey, and L.W. Robbins. 2010. Overlap in roosting habits of Indian bats (*Myotis sodalist*) and northern bats (*Myotis septentionalis*). American Midland Naturalist 163:115-123.

Turner, G.G., D.M. Reeder, and J.T.H. Coleman. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats, with a look at the future. Update on white-nose syndrome in bats. Bat Research News 52:13-27.

United States Fish and Wildlife Service (USFWS). 2015. Endangered and threatened wildlife and plants; threatened species. Status of the northern long-eared bat with 4(d) rule; final rule and interim rule. 50 CFR Part 17. Website: http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/FRnlebFinalListing02April2015.pdf [Accessed November 2015].

United States Fish and Wildlife Service (USFWS). 2016. Northern long-eared bat (Myotis septentrionalis). Website: http://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=A0JE [Accessed September 2016].

Vanderwolf, K.J., D.F. McAlpine, G.J. Forbes, and D. Malloch. 2012. Bat populations and cave microclimate prior to and at the outbreak of white-nose syndrome in New Brunswick. The Canadian Field-Naturalist 126: 125-134.

Vanderwolf, K.J., D.F. McAlpine, C.C. Ryan, and H.G. Broders. 2025. Pseudogymnoascus destructans environmental reservoir decreases 11 years after an outbreak of white-nose syndrome. Ecosphere 16(1): e70149.

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.

Verant, M.L., J.G. Boyles, W. Waldrep Jr., G. Wibbelt, and D.S. Blehert. 2012. Temperature-dependent growth of *Geomyces destructans*, the fungus that causes bat white-nose syndrome. PloS ONE 7: e46280. doi: 10.1371/journal.pone.0046280.

Verant, M.L., C.U. Meteyer, J.R. Speakman, P.M. Cryan, J.M. Lorch, and D.S. Blehert. 2014. White-nose syndrome initiates a cascade of physiologic disturbances in the hibernating bat host. BMC Physiology 14:10.

Vonhof, M.J. and D. Hobson. 2001. Alberta Species at Risk Report, No. 4: Survey of the bats of central and northwestern Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, Ab. 33 pp.

Vonhof. M.J., S. McNalley, and A. Yu. 1997. Roosting habitat requirements of northern long-eared bats (*Myotis septentrionalis*) in northeastern British Columbia: the Fort Nelson River and highway 77 area. [Report] Prepared for Ministry of Environment, Lands and Parks, Fort St. John, BC. 63 pp.

Wang, X., K. Students, M.A. Parisien, S.W. Taylor, J.N. Candau, Y. Boulanger, and M.D. Flannigan. 2020. Projected changes in fire size from daily spread potential in Canada over the 21st century. Environmental Research Letters 15(10): 104048.

Warburton, E.M, E. Swerdfeger, and J.L. Coleman. Urban Bats and their Parasites. 2023. *In* Urban Bats: Biology, Ecology, and Human Dimensions. Cham: Springer International Publishing. 17 pp.

Webb, P.I., J.R., Speakman, and P.A. Racey. 1996. How hot is a hibernaculum? A review of the temperatures at which bats hibernate. Canadian Journal of Zoology 74: 761-765.

Wek'èezhìı Renewable Resources Board (WRRB), unpublished data. 2026. Results of ultrasound acoustic monitoring done along the Tłı̨chǫ Highway in 2024. Data provided by A. Weltman (Conservation Biologist). Unpublished data, August 2024. Wek'èezhìı Renewable Resources Board, Yellowknife, NT.

West Ecosystems Analysis, unpublished data. 2024. Results of ultrasound acoustic monitoring done on the Dempster and Tuktoyaktuk highways in 2022. Data provided by E. West. Unpublished data, October 2024. West Ecosystems Analysis, Inc, Davis, CA.

White, D.H. and J.T. Seginak. 1987. Cave gate design for use in protecting endangered bats. Wildlife Society Bulletin 15:445-449.

White, J.A., P.W. Freeman, H.W. Otto, B.R. Andersen, J. Hootman, and C.A. Lemen. 2017. Autumn migration of Myotis septentrionalis in Nebraska: documentation of fall activity, migratory timing, and distance using radio-telemetry. Transactions of the Nebraska Academy of Sciences 37: 40-46.

White, J.A., P.W. Freeman, M.I. Shehan, and C.A. Lemen. 2022. Decline of the Northern Long-Eared Myotis (*Myotis septentrionalis*) in the Eastern Great Plains After the Arrival of White-nose syndrome. Western North American Naturalist 82(1): 86-93. https://doi.org/10.3398/064.082.0108

White-Nose Syndrome Response Team. 2026. White-Nose Syndrome/Pd Occurrence by County. Website: https://sciencebase.usgs.gov/nabat/#/wns/map [accessed 26 June 2026].

Wiebe, K.L. 2001. Microclimate of tree cavity nests: is it important for reproductive success in northern flickers? The Auk 118(2): 412-421.

Wilder, A.P. 2014. Spatial, ecological and genetic correlates of the geographic expansion of an infectious disease, white-nose syndrome in bats. PhD Dissertation, Boston University, Boston, MA. 136 pp.

Wilder, A.P., T.H. Kunz, and M.D. Sorenson. 2015. Population genetic structure of a common host predicts the spread of white-nose syndrome, an emerging infectious disease in bats. Molecular Ecology 24:5495-5506.

Wildlife Conservation Society (WNS) Canada. 2025a. Western Canada Bats and Bridges Project. Online webpage: https://www.albertabats.ca/bridges/. Accessed on November 2, 2025.

Wildlife Conservation Society (WNS) Canada. 2025b. WNS Probiotic Project. Online webpage: https://wcsbats.ca/probiotic. Accessed 5 Nov 2025.

Wildlife Conservation Society (WCS) Canada and Environment and Climate Change (ECC), unpublished data. 2025. Results of genetic analysis of samples collected for the Western Canada Bats and Bridges Project from 2022 to 2024. Data provided by C. Olson (Alberta Bat Program Coordinator, WCS Canada) and J. Wilson (Wildlife Biologist, Species at Risk, ECC). Unpublished data, December 2025. Wildlife Conservation Society Canada, Edmonton, AB and Government of the Northwest Territories, Yellowknife, NT.

Wilkinson, G.S. and J.M. South. 2002. Life history, ecology and longevity in bats. Aging Cell 1: 124-131.

Wilkinson, L.C., P.F.J. Garcia, and R.M.R. Barclay. 1995. Bat survey of the Liard River watershed in northern British Columbia. Report prepared for Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria, BC. 41 pp.

Wilkinson, L. pers. comm. 2026. Email exchange. Species at Risk and Stewardship Section, Environment and Protected Areas, Government of Alberta, Canada.

Willis, C.K.R., A.K. Menzies, J.G. Boyles, and M.S. Wojciechowski. 2011. Evaporative water loss is a plausible explanation for mortality of bats from white-nose syndrome. Integrative and Comparative Biology 51:364-373.

Wilson, D.E. and D.M. Reeder (Eds.). 2005. Mammal species of the world: a taxonomic and geographic reference. Third edition. The Johns Hopkins University Press, Baltimore. Two volumes. 2,142 pp. Website: http://www.bucknell.edu/msw3/ [Accessed March 2015].

Wilson, J.M. 2014. Bat monitoring in the NWT [Research Summary Report]. Associate with research permit number WL500121. Wildlife Division, Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 6 pp.

Wilson, J.M. 2016. Bat monitoring in the Northwest Territories: research progress report for April 2015-March 2016, associated with research permit number WL500317. Wildlife Division, Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 3 pp.

Wilson, J.M., J.P. Reimer, D. Allaire, and C.L. Lausen. 2014. Diversity and distribution of bats in the Northwest Territories. Northwestern Naturalist 95:197-218.

Wojciechowski, M.S., M. Jefimow, and E. Tegowska. 2007. Environmental conditions, rather than season, determine torpor use and temperature selection in large mouse-eared bats (*Myotis myotis*). Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology 147:828-840.

Wolf, K.D., P.E. Higuera, K.R. Davis, and S.Z. Dobrowski. 2021. Wildfire impacts on forest microclimate vary with biophysical context. Ecosphere12(5): e03467.

Wood Buffalo National Park. unpubl. report. 1981. Karst 3-10, airphoto analysis 1979. Received from S. Irwin, Resource Management Officer, Wood Buffalo National Park, Fort Smith, NT. Email contact: Sharon.Irwin@pc.gc.ca.

Yates, D.E., E.M. Adams, S.E. Angelo, D.C. Evers, J. Schmerfeld, M.S. Moore, T.H. Kunz, T. Divoll, S.T. Edmonds, and C. Perkins. 2014. Mercury in bats from the northeastern United States. Ecotoxicology 23(1): 45-55.

Zimmerling, J.R. and C.M. Francis. 2016. Bat mortality due to wind turbines in Canada. Journal of Wildlife Management (online), July 26, 2016. Website: http://onlinelibrary.wiley.com/doi/10.1002/jwmg.21128/full [Accessed August 2016]

Zukal, J., H. Bandouchova, J. Brichta, A. Cmokova, K.S. Jaron, M. Kolarik, V. Kovacova, A. Kubátová, A. Nováková, O. Orlov, J. Pikula, P. Presetnik, J. Šuba, A. Zahradníková Jr. and N. Martínková. 2016. White-nose syndrome without borders: Pseudogymnoascus destructans infection tolerated in Europe and Palearctic Asia but not in North America. Scientific Reports 6(1): 1-17.

APPENDIX A

DESCRIPTION

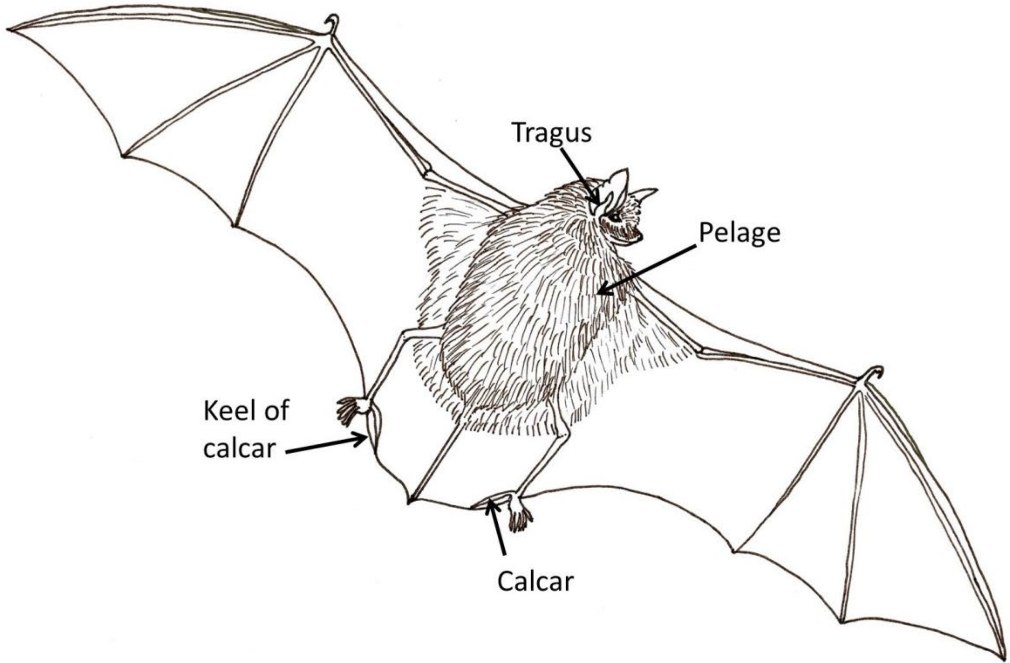

Figure 21. Depiction of key anatomical terms in text. Figure courtesy B. Fournier.

CALCULATING GENERATION TIME

Due to a lack of data to populate a life history table for little brown myotis or northern myotis, generation time (generation length) for each species was calculated using the R*span* approach as used by Pacifici *et al.* (2013) and IUCN (2014):

$$GL = R_{span} * z + AFR$$

GL is generation length

R_{span} is the species-specific reproductive lifespan (maximum age minus *AFR*)

z is a constant that accounts for the survivorship and relative fecundity of young verses old individuals in the population. Adequate data was not available to calculate this value, we therefore used a z-value of 0.29 as calculated by Pacifici *et al.* (2013) based on the relationship between generation length and reproductive lifespan for 221 mammal species.

AFR is the age of first reproduction, which we estimated for each species at 640 days. Little brown myotis and northern myotis are physically mature enough to reproduce after their first year (365 days), however, there are many environmental variables that cause females to delay reproduction until their second year (see *Lifecycle and reproduction*). This estimation assumes that 75% of the population delays reproduction until their second year, although the exact value for each species is unknown.

Table A1. Species-specific calculation values for generation time of the little brown myotis (M. lucifugus) and northern myotis (M. septentrionalis).

Common Name ***Scientific Name***	**Max. Age (days)**[1]	**R_{span} (days)**	**AFR (days)**	**z**	**GL (days)**	**GL (years)**[2]
Little brown myotis (*Myotis lucifugus*)	12,410	11,770	640	0.29	4,053	11.1
Northern myotis (*Myotis septentrionalis*)	6,935	6,295	640	0.29	2,446	6.8

[1] Maximum ages used for the calculation were: *Myotis lucifugus* 34 years (Davis and Hitchcock 1965; Keen and Hitchcock 1980) and *Myotis septentrionalis* 19 years (Kurta 1995 in Wilkinson and South 2002).

[2] Generation times calculated for each species are comparable to the values reported by IUCN Red list; *Myotis lucifugus* 5-10 years and *Myotis septentrionalis* 6 years. Different values resulted from using some different estimates for maximum age and age at first reproduction.

REGIONAL/CULTURAL INFORMATION

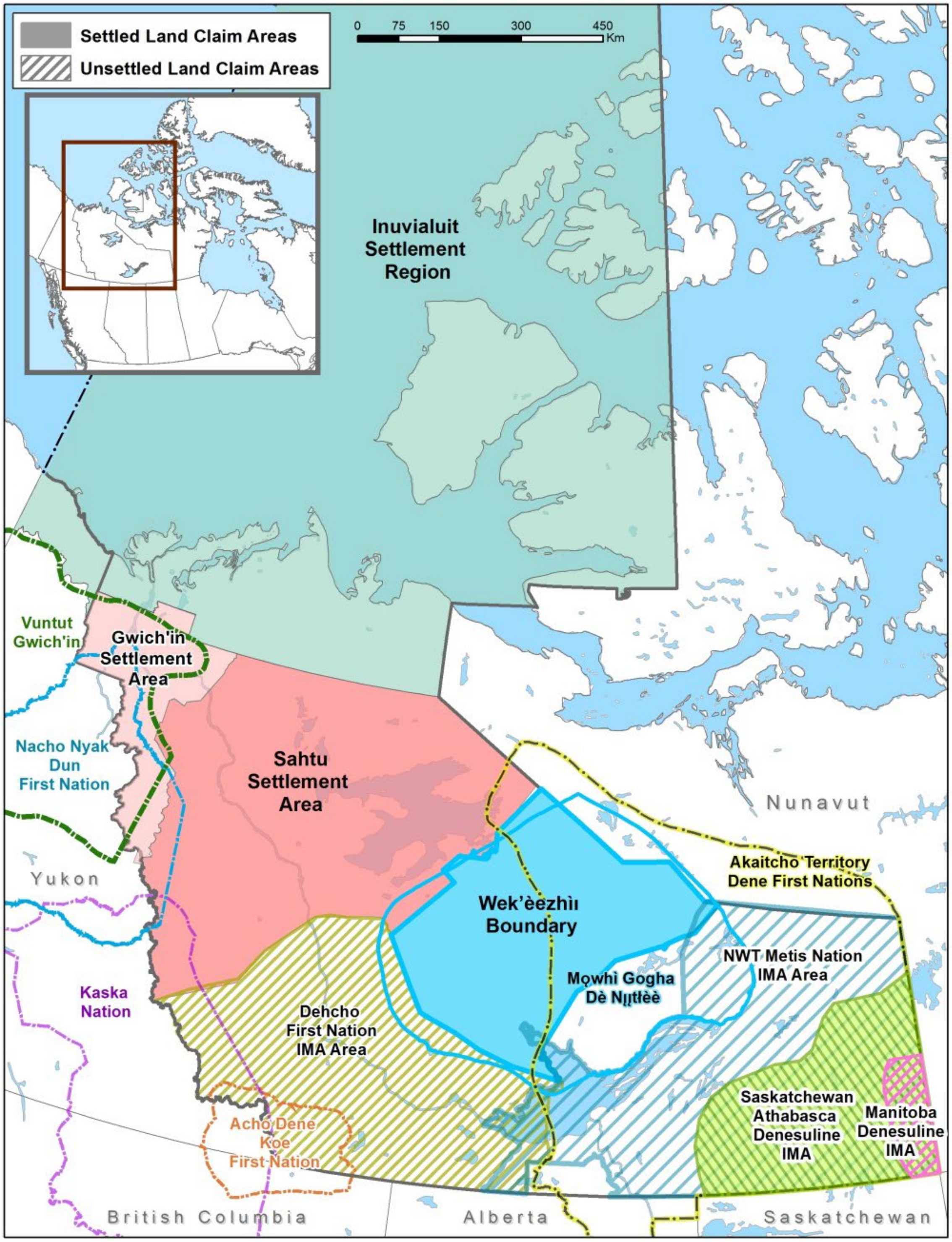

Figure 20. Settlement areas in the NWT.

DATA SOURCES FOR MAPS

Data include recordings from several acoustic monitoring programs: for NABat from 2021 to 2023 (ECC unpubl. data 2026; Parks Canada 2024); at Pine Point in 2018 (Golder Associates 2018); around Howard's Pass in 2019 (EDI 2021); at Old Fort Rae in 2024 (NSMA unpubl. data 2026); along the Tłı̨chǫ Highway in 2024 (WRRB unpubl. data 2026); for the NWT Biodiversity Monitoring Program (NTBMP) east of the Slave River in the Fort Smith area and along the Mackenzie Valley Winter Road, both in 2023 (NTBMP unpubl. data 2025); and opportunistic monitoring at various locations in southern NWT and the Sahtú region from 2021 to 2023 (ECC unpubl. data 2026).

Data also include bat captures, specimens and guano collected through various studies: the Bats and Bridges project conducted from 2022 to 2024 (WCS Canada and ECC unpubl. data 2025); monitoring at little brown myotis maternity colonies up to 2025 (ECC unpubl. data 2025a); cave and karst surveys in Nahanni National Park reserve in 2016 and 2019 (Horne and Critchley 2019; Parks Canada unpubl. data 2025); and observations submitted to GNWT-ECC and compiled for the Wildlife Management Information System (WMIS) (ECC unpubl. data 2025b).

Additional studies were checked for potential occurrences however no bats were recorded during these surveys. These include a field capture survey for bats at Old Fort Rae in 2025 (NSMA unpubl. data 2026) as well as the following acoustic monitoring programs: for the NTBMP in the Norman Wells area in 2023 (NTBMP unpubl. data 2025); by Ed West along the Dempster and Tuktoyaktuk highways in 2022 (West Ecosystems Analysis unpubl. data 2024); in the Gwich'in Settlement Area from 2019 to 2021 and in 2025 (GRRB unpubl. data 2022; GRRB unpubl. data 2026); and in collaboration with SRRB, RRCs, University of Alberta and GNWT-ECC in the Sahtú region in 2021 (Hurtado unpubl. data 2024).

APPENDIX B – THREATS ASSESSMENT

Threats Assessment[6]

Threats have been classified for little brown myotis and Northern myotis in the NWT only (i.e., not including threats that may be present in neighbouring jurisdictions). The threats assessment is based on whether threats are of concern for the sustainability of the species in the NWT over approximately the next 10 years.

This threats assessment was completed collaboratively by members of the NWT Species at Risk Committee, at a meeting on June 25, 2026. The threats assessment will be reviewed and revised as required when the status report is reviewed in 10 years or at the request of a Management Authority or the Conference of Management Authorities. Parameters used to assess threats are listed in Table.

Table B1. Parameters used in threats assessment.

Parameter	Description	Categories
LIKELIHOOD		
Timing (i.e., immediacy)	Indicates if the threat is presently happening, expected in the short term (<10 years), expected in the long term (>10 years), or not expected to happen.	Happening now Short-term future Long-term future Not expected
Probability of event within 10 years	Indicates the likelihood of the threat to occur over the next 10 years.	High Medium Low
CAUSAL CERTAINTY		
Certainty	Indicates the confidence that the threat will have an impact on the population.	High Medium Low
MAGNITUDE		

[6] This approach to threats assessment represents a modification of the International Union for the Conservation of Nature's (IUCN) traditional threats calculator. It was originally modified for use in the Inuvialuit Settlement Region Polar Bear Joint Management Plan (Joint Secretariat 2017). This modified threats assessment approach was adopted as the standard threats assessment method by the Species at Risk Committee and Conference of Management Authorities in 2019.

Extent (scope)	Indicates the spatial extent of the threat (based on percentage of population or area affected)	Widespread (>50%) Localized (<50%)
Severity of population-level effect	Indicates how severe the impact of the threat would be at a population level if it occurred.	High Medium Low Unknown
Temporality	Indicates the frequency with which the threat occurs.	Seasonal Continuous
Overall level of concern	**Indicates the overall threat to the population (considering the above).**	**High** **Medium** **Low**

Overall Level of Concern

The overall level of concern for threats to little brown myotis and Northern myotis are noted below. Please note that combinations of individual threats could result in cumulative impacts to little brown myotis and Northern myotis in the NWT. Details can be found in the *Detailed Threats Assessment*.

Overall level of concern:

- **Threat 1 – *Pseudogymnoascus destructans (Pd)* causing White-nose syndrome (WNS)** **High**
- **Threat 2 – Climate Change – Drought** **High**
- **Threat 3 – Climate Change – Wildfire** **Medium**
- **Threat 4 – Exclusion from or removal of maternity roosts** **Medium-Low**
- **Threat 5 – Human activities impacting bats at hibernacula** **Low**
- **Threat 6 – Physical Changes to Hibernacula** **Low**
- **Threat 7 – Timber Harvest** **Low**

Detailed Threats Assessment

Threat #1. *Pseudogymnoascus destructans* (*Pd*) causing White-nose syndrome (WNS)		
Specific threat	White-nose syndrome (WNS) is a fungal disease caused by *Pseudogymnoascus destructans* (*Pd*) that infects hibernating bats, particularly in cool, humid cave environments. *Pd* and WNS affect many species of bats including little brown myotis and northern myotis. The fungus spreads through bat-to-bat contact, contaminated cave surfaces, and human activity, and can persist in hibernacula for long periods. Since its detection in North America in 2006–2007, WNS has spread rapidly at an average rate of 200-250 km per year across most of the North American continent. WNS was documented in Alberta in 2023 and *Pd* was found as far north as Fort McKay, AB in 2025. There was also an extreme bat fatality event due to WNS at Cadomin Cave (approximately 670 km from the NWT) that was documented during the winter of 2025-2026. During bat monitoring efforts in May 2026, white-nose syndrome was confirmed in a northern myotis near Fort Smith, at a site that is also used by little brown myotis and big brown bats. Additionally, the fungus that causes WNS was detected in bat guano (feces) at Hay River.	
Stress	WNS causes severe physiological stress by infecting bat skin and disrupting winter hibernation, leading to frequent arousals that deplete fat reserves and cause dehydration and death. There is no known cure, and mortality rates are extremely high. It is estimated to have resulted in the deaths of 90% of little brown myotis across 36% of their range and 90% of northern myotis across 79% of their range. Surviving bats may experience reduced summer activity and potentially lower reproductive success, placing long-term pressure on population recovery and persistence. Further spread of *Pd* within the NWT is expected. Over time, it may reach and affect bat populations across the territory. The ultimate impacts of WNS on bat populations in the NWT are uncertain, as this is the first time that the disease has reached this far north. However, anticipated effects include bat mortalities at hibernation sites and declines in our bat populations. Both have the potential to be severe.	
Species:	**Little Brown Myotis**	**Northern Myotis**
Extent	Widespread (>50%)	Widespread (>50%)
Severity	High	High
Temporality	Continuous	Continuous
Timing	Happening now	Happening now

Probability	High	High
Causal certainty	High	High
Overall level of concern	**High**	**High**

Threat #2. Climate Change – Drought		
Specific threat	Prolonged drought conditions in the NWT are contributing to low lake and river levels. Across the entire southern portion of the territory, drought intensity was classified as severe or extreme in 2025. Periods of drought occur naturally; however prolonged drought conditions may pose a significant risk to bat species. These changes limit access to key resources for bats, including drinking water, aquatic insect prey, and suitable roosting habitat, while also increasing risks such as wildfire and tree disease that further alter the landscape.	
Stress	Female little brown myotis typically select roosts within one kilometre of water sources, and northern myotis select roosts within 750 metres of water sources. Low water availability may not impact pregnancy rates, however in years of low stream discharge rates, the frequency of lactating females declined by up to 50%, suggesting that lactation may not be supported if females do not have sufficient access to water. Drought results in declines in insect populations, which may result in both reduced access to water and food for insectivorous bats. Reduced energy intake, particularly for bats preparing to enter hibernation, may be detrimental to future reproduction and overwinter survival. Drought also impacts the forests that bats use for roosting and foraging, through increased risk of large and severe wildfires, water stress, and increased risk of diseases that impact trees. Ultimately, this increases energetic costs and potentially lowers survival and reproductive success.	
Species:	**Little Brown Myotis**	**Northern Myotis**
Extent	Widespread (>50%)	Widespread (>50%)
Severity	High	High
Temporality	Seasonal	Seasonal
Timing	Happening now	Happening now

Probability	High	High
Causal certainty	High	High
Overall level of concern	**High**	**High**

Threat #3. Climate Change – Wildfire		
Specific threat	Climate-driven changes in wildfire regimes in the northern boreal forest are leading to more frequent, larger, and higher-severity fires. These fires can substantially alter bat habitat by reducing forest cover, removing large roost trees, and changing microclimate conditions, while also affecting the availability and composition of insect prey. Repeated burning can prevent the recruitment of new, mature trees and forests further limiting the long-term availability of suitable habitat. In the extreme wildfire season of 2023 in the NWT, there were increased reports of bats present in communities. Bats appeared to be using communities as refugia during these events, causing an increase in human-bat interactions.	
Stress	These habitat changes can reduce the availability and quality of both roosting and foraging sites, forcing bats to travel farther and expend more energy to meet their needs. Loss of large cavity trees and reduced canopy cover can make roosts less suitable, particularly for reproductive females, while altered prey availability may affect food resources. Additionally, wildfire smoke has the potential to negatively impact bats, this impact is pronounced when bats are using torpor or entering hibernation in autumn.	
Species:	**Little Brown Myotis**	**Northern Myotis**
Extent	Widespread (>50%)	Widespread (>50%)
Severity	Unknown	Unknown
Temporality	Continuous	Continuous
Timing	Happening now	Happening now
Probability	High	High
Causal certainty	Low	Low

Overall level of concern	**Medium**	**Medium**

Threat #4. Human Impacts – Exclusion from or removal of maternity roosts		
Specific threat	Exclusion of bats from maternity roosts (e.g., sealing entrances on buildings) and removal of natural roosts such as trees through development or forestry can displace or eliminate critical breeding habitat. These actions often occur in response to human-wildlife conflict or land use changes and can disrupt established colonies, especially when suitable alternative roosts are limited.	
Stress	Displacement from maternity roosts can affect individual fitness, reduce reproductive success, increase energy expenditure as bats search for new sites, or lead to colony abandonment. If exclusion or tree removal occurs during the breeding season, dependent pups and/or juveniles may be left behind, resulting in direct mortality from dehydration and starvation. Over time, these impacts can lower survival and recruitment, contributing to local population declines.	
Species:	**Little Brown Myotis**	**Northern Myotis**
Extent	Localized (<50%)	Localized (<50%)
Severity	Low	Low
Temporality	Seasonal	Seasonal
Timing	Happening now	Happening now
Probability	High	High
Causal certainty	Medium-Low	Medium-Low
Overall level of concern	**Medium-Low**	**Medium-Low**

Threat #5. Human activities impacting bats at hibernacula	
Specific threat	Human activities at bat hibernacula (for example, recreational cave visits, research access, and nearby industrial operations) can disturb hibernating bats. Disturbance may occur through noise, light, vibration, or direct handling.

Stress	Disturbance during hibernation forces bats to arouse from torpor, which significantly increases energy consumption and depletes limited fat reserves needed to survive the winter. Repeated or prolonged disturbance can lead to starvation, reduced fitness, physical injury, or mortality, ultimately lowering survival rates and potentially contributing to population decline. In the NWT, the precise locations of winter hibernation sites are considered classified, and to reduce human traffic, these sites are not readily shared with the public. In addition, the NWT *Wildlife Act* prevents the possession, transportation, and importing of bats. GNWT-ECC has also been developing a Cave Management Plan for hibernacula in the NWT. And all bat research and monitoring in the NWT must follow decontamination protocols to prevent spreading *Pd* or WNS. With these management and mitigation processes in place, research activities on bats is not considered a threat.		
Species:	**Little Brown Myotis**	**Northern Myotis**	
Extent	Localized (<50%)	Localized (<50%)	
Severity	Low	Low	
Temporality	Seasonal	Seasonal	
Timing	Short-term future	Short-term future	
Probability	Medium	Medium	
Causal certainty	Low (if activity is low) High (if activity is high)	Low (if activity is low) High (if activity is high)	
Overall level of concern	**Low**	**Low**	

Threat #6. Human Impacts – Physical Changes to Hibernacula	
Specific threat	Activities may alter the cave environment and cause changes to cave conditions (e.g., temperature, humidity, airflow, and the ability of bats to access the cave) through activities like gating, mining, quarrying, forestry, or infrastructure development.
Stress	Altering cave conditions has the potential to reduce the quality of habitat, which significantly increases energy consumption and depletes limited fat reserves needed to survive the winter. This can lead to displacement,

	starvation, reduced fitness, physical injury, or mortality, ultimately lowering survival rates and potentially contributing to population decline. In the NWT, the precise locations of winter hibernation sites are not readily shared and this makes avoiding hibernacula difficult.	
Species:	**Little Brown Myotis**	**Northern Myotis**
Extent	Localized (<50%)	Localized (<50%)
Severity	High	High
Temporality	Continuous	Continuous
Timing	Long-term future	Long-term future
Probability	Low	Low
Causal certainty	Medium-Low	Medium-Low
Overall level of concern	**Low**	**Low**

Threat #7. Human Impact – Timber Harvest		
Specific threat	Timber harvest can decrease available habitat for roosting and foraging. The direct loss of roost trees can increase the distance traveled between subsequent roosts. Timber harvest also affects foraging habitat. Harvested areas can provide edge habitat for little brown myotis to commute and forage, while northern myotis avoid clearcuts and remain in intact forest	
Stress	Loss of roost trees can lead to smaller colony sizes and force bats to travel farther between roosts, increasing energy expenditure and reducing reproductive success. Changes to forest structure may also limit suitable foraging areas, especially for species like northern myotis that prefer intact forests, ultimately increasing energetic demands and contributing to reduced survival and population declines.	
Species:	**Little Brown Myotis**	**Northern Myotis**
Extent	Localized (<50%)	Localized (<50%)
Severity	Low	Low
Temporality	Continuous	Continuous

Timing	Happening now	Happening now
Probability	High	High
Causal certainty	Low	Low
Overall level of concern	**Low**	**Low**