Diversity and Distribution of Bats in the Northwest Territories

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DIVERSITY AND DISTRIBUTION OF BATS IN THE NORTHWEST TERRITORIES

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ABSTRACT—The occurrence of bats at the northern limit of their ranges in the Northwest Territories (NT), Canada, is not well documented. We provide information on the diversity and distribution of bat species in the NT by synthesizing available records. Before 2006, only 3 species of bats were known to occur in the NT: Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*M. septentrionalis*), and Hoary Bat (*Lasiurus cinereus*). Focused bat surveys as well as observations of bats reported by residents have added Long-eared Myotis (*M. evotis*), Long-legged Myotis (*M. volans*), Big Brown Bat (*Eptesicus fuscus*), and Silver-haired Bat (*Lasionycteris noctivagans*), for a total of 7 confirmed species, plus an additional species that is unconfirmed but suspected to occur (Eastern Red Bat, *Lasiurus borealis*). Range extensions for Little Brown Myotis, Hoary Bat, and Silver-haired Bat are reported. Both Little Brown Myotis and Northern Myotis are reproducing in the NT and are likely abundant in southern NT. Little Brown Myotis has been confirmed to overwinter in the NT and the northern limit of bat hibernation may be further north than previously supposed. Bats are widespread in the southern Central Plains region and gaps in occurrences likely reflect gaps in search effort. Nahanni National Park Reserve has high bat diversity and other parts of southwestern NT are suspected to have similarly high diversity, but have not yet been surveyed. There is evidence that the Eastern Shield region supports bats at relatively low densities. The northern distribution limit of bats in the NT is not known but is expected to occur in the Mackenzie Valley north of 62°N.

Key words: bats, distribution, diversity, *Eptesicus*, *Lasiurus*, *Lasionycteris*, latitude, *Myotis*, Northwest Territories, range

In the Northwest Territories (NT), Canada, the distribution of bats reaches a northern limit. Where this limit occurs is likely determined by the availability of summer and winter roosts with suitable microclimates as well as the availability of sufficient foraging opportunities (access to insects at night; Humphrey 1975; Parker and others 1997; Kunz and Lumsden 2003). The distribution and diversity of bat species in the NT is not well documented due to the territory's large area, sparse population and very few roads, as well as the relatively low management priority given to bats in the past. Nevertheless, the state of knowledge has advanced significantly since bat distribution data were summarized by van Zyll de Jong (1985) and Naughton (2012).

Updated information on the diversity and distribution of NT bats can provide information for monitoring, management, and research

needs, and the NT presents opportunities to study the ecology of bats at high latitude. It has been predicted that some bat species may extend their range further northward in the NT as climate warms (Humphries and others 2002), but detecting and understanding such changes, if they occur, requires baseline knowledge. The management priority for bats is increasing because white-nose syndrome, a disease that has decimated hibernating bat populations in eastern North America, is spreading westward (Frick and others 2010; Turner and others 2011). Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*) have been assessed as Endangered in Canada because of the threat of white-nose syndrome (COSEWIC 2012a, 2012b), which raises their profile for management. Monitoring and management of this disease when and if it arrives in the NT will require an understanding of which susceptible bat species occur in the NT, where they raise young, and where they overwinter.

Prior to 2006, little effort was made to survey bats in the NT. Explorers and naturalists traveling in the southern NT during the 1800s and early 1900s recorded occasional bat observations but did not target bats. In the 1970s, ecological surveys in Nahanni National Park Reserve (NNPR) in southwestern NT recorded bats as part of general wildlife inventories. The objective of this review was to compile and synthesize all available information on the diversity and distribution of bats in the NT, including the literature, museum records, opportunistic sightings, and our own recent field studies.

Methods

Study Area

The NT is located in Canada north of 60°N. Within mainland NT we refer to 4 distinct ecological regions (Fig. 1): Western Mountains, Central Plains, Eastern Shield, and Northern Tundra. These regions are similar to ecozones defined by the Ecological Stratification Working Group (1996) (Boreal and Taiga Cordillera, Taiga Plains, Taiga Shield, and Southern Arctic, respectively), but we used a more recent ecosystem classification for the NT (Ecosystem Classification Group 2007 [rev. 2009], 2008, 2010, 2012). The ecological regions are based on climate, physiography, and vegetation patterns. They influence habitat and are relevant to the distribution of species.

The Western Mountains region of NT includes the Mackenzie Mountains and Richardson Mountains. The region is a complex landscape of rugged peaks and ridges, rolling hills, eroded plateaus, deep valleys, rivers, streams, and glaciers. Vegetation communities vary greatly with altitude and latitude. Important species of forested areas include Black Spruce (*Picea mariana*), White Spruce (*P. glauca*), Balsam Poplar (*Populus balsamifera*), and Paper Birch (*Betula papyrifera*). Lodgepole Pine (*Pinus contorta*), Jack Pine (*P. banksiana*), Trembling Aspen (*Populus tremuloides*), and Rocky Mountain Subalpine Fir (*Abies bifolia*) also occur in the southern part of this region (Ecosystem Classification Group 2010).

The Central Plains of NT are primarily underlain by sedimentary rock with flat or slightly rolling terrain and some canyons. This region is dominated by the Mackenzie River drainage in the west and Great Slave Lake and Great Bear Lake in the east. There is widespread permafrost and large areas are waterlogged. Fires are common and there is a patchwork of forest types with tree species including Black Spruce, White Spruce, Tamarack (*Larix laricina*), Paper Birch, Alaska Paper Birch (*Betula neoalaskana*), Dwarf Birch (*Betula glandulosa* and *B. nana*), Willow (*Salix* spp.), Trembling Aspen, Balsam Poplar, and Jack Pine. The southern part of this region has species-rich mixed-wood forests. Moving north, mixed-wood forests, Jack Pine, Trembling Aspen, and Balsam Poplar become less common and there are more slow-growing coniferous forests with comparatively low species diversity and Black Spruce-dominated wetlands. The northern part of this region has fewer wetlands and open, stunted forests of mainly White Spruce (Ecosystem Classification Group 2007 [rev. 2009]).

The Eastern Shield region of NT lies on the granite bedrock of the Canadian Shield. This region has a rolling terrain of bedrock plains and rugged bedrock hill systems with extensive glacial till deposits. There are nearly 200,000 lakes in this region, most of which are isolated or connected by small local drainage systems. The Eastern Shield generally has more open and stunted forests compared to the Central Plains.

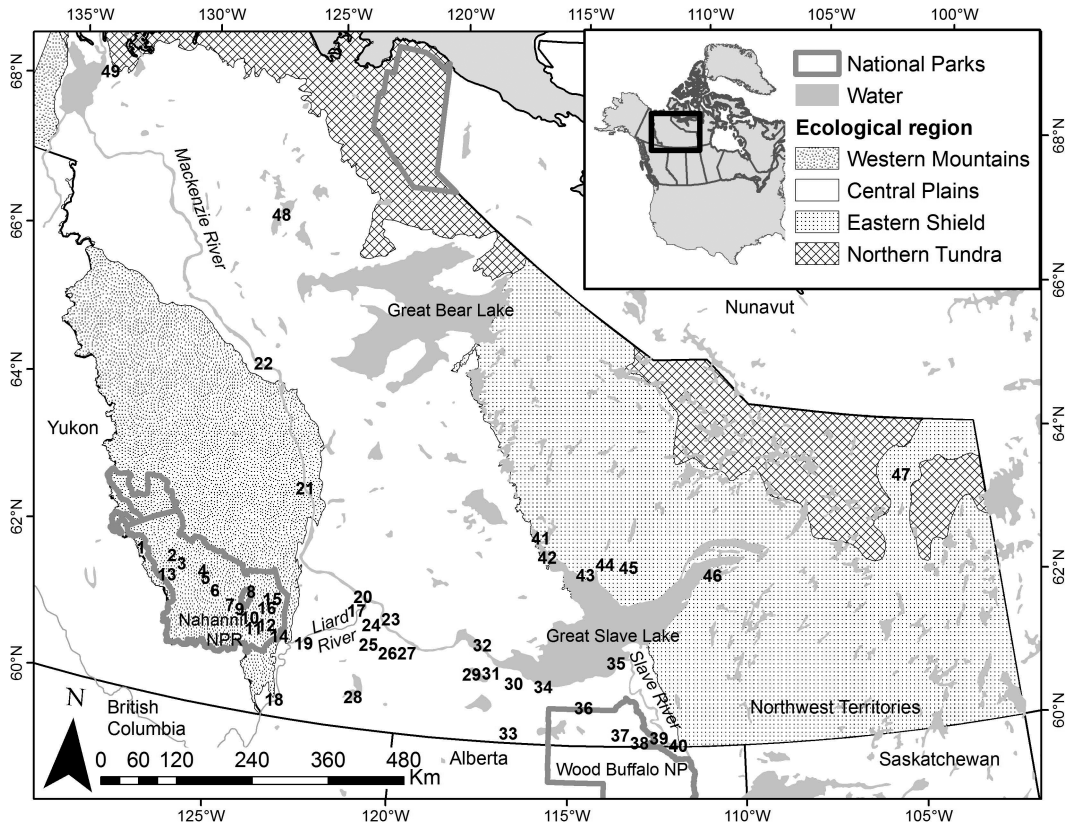

FIGURE 1. Ecological regions and selected place names in mainland Northwest Territories. The 'Western Mountains' region is made up of the Tundra Cordillera, Taiga Cordillera and Boreal Cordillera Level II Ecoregions (Ecosystem Classification Group 2010). The 'Central Plains' region is the Taiga Plains Level II Ecoregion (Ecosystem Classification Group 2007 [rev. 2009]). The 'Eastern Shield' region is the Taiga Shield Level II Ecoregion (Ecosystem Classification Group 2008). The 'Northern Tundra' is the Tundra Level I Ecoregion (Ecosystem Classification Group 2012). The southern boundary of the Northern Tundra region approximates tree line. Arctic islands of NT are not shown. Numbers correspond to the locations of place names in Appendix 1.

Jack Pine is important in the western portion of this region. Open, low-growing Black Spruce forests with lichen and shrub understories are dominant in many areas. White Spruce, Dwarf Birch, Paper Birch, and Trembling Aspen also occur in some areas (Ecosystem Classification Group 2008).

The Northern Tundra region of NT occurs north of tree line. It is an almost entirely treeless landscape of coastal plains, and upland hills and plateaus with some broad, deep valleys. Major vegetation species of the Northern Tundra include Dwarf Birch, Mountain Avens (*Dryas* spp.), Black Crowberry (*Empetrum nigrum*), Bearberry (*Arctostaphylos* spp.), Arctic Lupine (*Lupinus arcticus*), lichens, mosses, sedges, and herbs (Ecosystem Classification Group 2012).

The climate of NT is characterized by relatively short summers with prolonged periods of daylight and cool temperatures, and long, cold winters. The latitudinal tree line extends diagonally from about 64°N in southeastern NT to about 68.5°N in northwestern NT. Spring and summer isotherms generally follow a similar pattern with warmer temperatures extending further north in the Central Plains than the Eastern Shield. The Central Plains region warms up sooner in spring and is generally warmer in summer compared to the Eastern Shield at similar latitude (Bonsal and Prowse 2003; Fig. 2). In the southern half of NT, mean annual

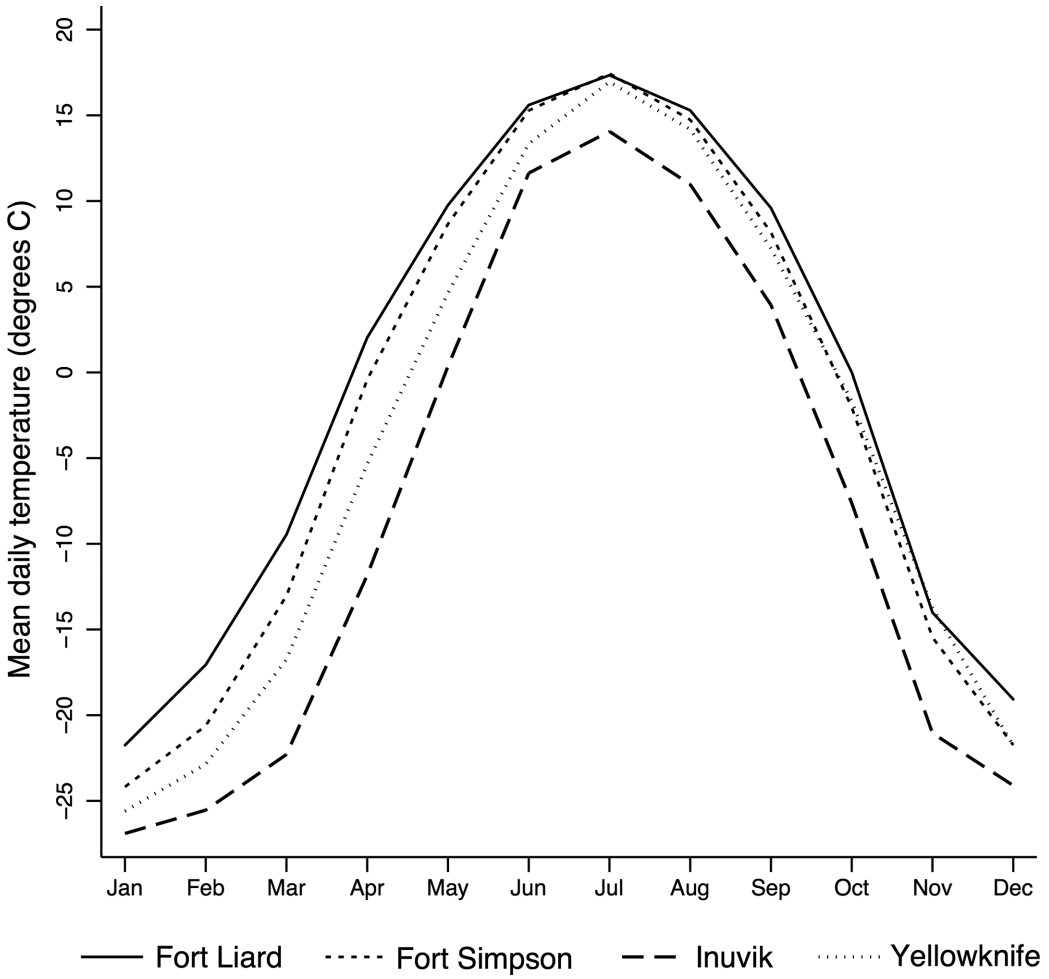

FIGURE 2. Historic climate normals for 4 weather stations in the Northwest Territories (Environment Canada 2013). Calculations are derived from a minimum 15 years of data between 1981 and 2010. Locations are Fort Liard (Central Plains; 60.3°N); Fort Simpson (Central Plains; 61.9°N); Yellowknife (Eastern Shield; 62.4°N); and Inuvik (Central Plains; 68.3°N).

temperature is approximately −4 to −8°C in the Western Mountains, −1 to −4.5°C in the Central Plains, and −3 to −9°C in the Eastern Shield (Ecosystem Classification Group 2007 [rev. 2009], 2008, 2010). Figure 2 shows mean daily temperature at some representative locations. The approximate coordinates for place names used are provided in Appendix 1 and mapped in Figure 1.

Data Sources

Literature and Museum Records.—We compiled records of bats in the NT from a review of the literature, including unpublished government reports, and from mammal collections of selected museums in Canada and the USA by searching MaNIS (http://manisnet.org/) and Arctos (http://arctos.database.museum/home.cfm) online databases, as well as those for the University of Alberta Museum of Zoology, Royal Ontario Museum, United States National Museum of Natural History (Smithsonian Institution), Canadian Museum of Nature, Provincial Museum of Alberta, and Royal British Columbia Museum. We did not examine specimens held in various collections to confirm their identification. When exact locations of bat

observations or collections were not known, we estimated locations based on place names and used only those place names that were clearly inside the NT.

Opportunistic Records.—Recently, there have been increased efforts in the NT to record opportunistic observations of bats, including from the public. Opportunistic observations can help to fill data gaps in areas where focused research has not yet taken place. The NT Department of Environment and Natural Resources maintains a database of opportunistic bat sightings reported by researchers, staff, and the public (Environment and Natural Resources 2013). Most of these sightings could not be reliably identified to species; however, photographs and specimens submitted by local observers occasionally allowed species identification based on external morphology. We compiled NT bat records from this database up to December 2013.

Field Studies.—We conducted field studies on bats from 2006 to 2013 in 3 areas of NT: NNPR, and near the communities of Kakisa and Fort Smith (Fig. 1; Lausen 2011; Reimer 2013; Reimer and Kaupas 2013; Lausen and others 2014; JP Reimer, unpubl. data). Bats were live-captured using mist nets, identified, and released. Bats were identified based on external morphology using characters such as general appearance, body size, fur color, ear and tragus length and shape, and presence or absence of a calcar (Nagorsen and Brigham 1993). In some cases species identification was corroborated by genetic analysis.

We used zero-crossing acoustic bat detectors to record the echolocation calls of passing bats in 6 areas of NT: NNPR, Fort Simpson, Kakisa area, Trout River (Sambaa Deh), Fort Smith area, and Yellowknife. Detectors were deployed approximately 1–2 m above the ground at water bodies, at known roosts, and along suspected fly ways. We used AnaBat II zero-crossing ultrasonic detectors with CF-ZCAIMS (Titley Scientific, Australia), as well as SM2BAT detectors (Wildlife Acoustics, USA; Lausen 2011; Lausen and others 2014; JP Reimer, unpubl. data; NT Environment and Natural Resources, unpubl. data; JM Wilson, unpubl. data). Although many echolocation calls cannot be reliably identified to species due to overlapping call characteristics, some calls possess diagnostic features that allow identification to the species level (Fenton and Bell 1981; Brigham and others 2004). Echolocation calls were analyzed and identified by an experienced analyst (Cori L Lausen) using the methods and criteria detailed in Lausen and others (2014).

Evidentiary Standards

The evidence available to substantiate bat occurrence records varied among the sources. We developed evidentiary standards to assess the occurrence data (*sensu* McKelvey and others 2008). We assessed records substantiated by a capture or specimen allowing species identification based on morphology or genetics as 'confirmed'. Photographs were only used to confirm species identification in the case of the Silver-haired Bat (*Lasionycteris noctivagans*). Little Brown Myotis and Northern Myotis identified from photographs based on the shape of the ear and tragus were assessed as 'unconfirmed' because of the possibility of misidentification. We assessed all sightings as 'unconfirmed.' Similar to Slough and others (2014) and Blejwas and others (2014), we assessed acoustic recordings of Hoary Bat (*Lasiurus cinereus*) as 'confirmed' because no other bat species in northwestern North America produces calls of that frequency and duration. We assessed all other acoustic recordings identified to species as 'unconfirmed' because of the possibility of misidentification. Acoustic recordings that were clearly bats but could not be identified to species were 'confirmed' as a bat, but the species was unknown.

RESULTS

We compiled 178 observation events of bats in NT between 1833 and 2013 (Appendix 2), 56.7% of which were attributable to a species (both confirmed and unconfirmed; Table 1). Most observation events of bats in NT were of visual sightings (31.5%) and acoustic recordings (31.5%), followed by live captures (26.4%), specimens (7.3%), and photographs (3.4%). All live captures and acoustic recordings were obtained between 2005 and 2013. Table 1 summarizes the occurrence of bat species in different ecological regions of the NT.

The occurrence of Little Brown Myotis is well documented from live captures and specimens from NNPR (n = 11 confirmed individual bat

TABLE 1. Summary of 178 bat observation events in 3 ecological regions in the NT, 1833–2013 (S = specimen; C = live capture; A = acoustic recording; P = photograph; V = visual sighting). Values represent an observation event at a specific location during a variable observation period (<1 y), not the number of specimens, captures, acoustic recordings, photographs, or visual sightings (i.e., each observation event may constitute ≥1 specimens, captures, etc., from a particular location during a sampling session). See Methods for details on types of records that provided sufficient evidence to confirm presence for each species. See Appendix 2 for data sources. Two bats from Great Slave Lake could not be identified to ecological region.

	Ecological Region														
	Western Mountains					Central Plains					Eastern Shield				
Species	S	C	A	P	V	S	C	A	P	V	S	C	A	P	V
Little Brown Myotis (*Myotis lucifugus*)	1	6	4	-	1	9	16	5	1	-	-	1	-	-	-
Northern Myotis (*Myotis septentrionalis*)	1	2	2	-	-	1	15	-	1	-	-	-	-	-	-
Long-eared Myotis (*Myotis evotis*)	-	1	5	-	-	-	-	-	-	-	-	-	-	-	-
Long-legged Myotis (*Myotis volans*)	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Big Brown Bat (*Eptesicus fuscus*)	-	-	1	-	2	-	4	3	-	-	-	-	-	-	-
Silver-haired Bat (*Lasionycteris noctivagans*)	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
Hoary Bat (*Lasiurus cinereus*)	-	-	1	-	-	-	-	8	-	1	-	-	1	-	-
Eastern Red Bat (*Lasiurus borealis*)	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
Unidentified Bat Species	-	-	13	-	7	-	-	8	3	30	-	-	3	-	13

records), the Mackenzie River Valley (n = 256), and south of Great Slave Lake (n = 699). There is 1 confirmed record each of Little Brown Myotis from north of Great Bear Lake, North Arm of Great Slave Lake, and Yellowknife (n = 3; Fig. 3A; Appendix 2). The probable regular occurrence of Little Brown Myotis in the Yellowknife area is supported by a live capture and multiple recordings of high frequency echolocation calls in the city during the summer, as well as several reported sightings of bats in and around the city (Environment and Natural Resources 2013; Environment and Natural Resources, unpubl. data; JM Wilson, unpubl. data).

The occurrence of Northern Myotis has been confirmed from live captures and specimens from NNPR (n = 4), the Mackenzie River Valley (n = 4), and south of Great Slave Lake (n = 101). Unconfirmed acoustic, visual, and photographic records also exist for these areas (Fig. 3B; Appendix 2). Northern Myotis may be relatively common in these areas, as it is in northeastern Alberta (Grindal and others 2011; Reimer and others 2014).

Lausen and others (2014) captured Long-eared Myotis (*Myotis evotis*; n = 1) and Long-legged Myotis (*Myotis volans*; n = 3) in NNPR. Identification of Long-eared Myotis was confirmed genetically. There are no records of these species from elsewhere in the NT (Fig. 3C, 3D).

There are unconfirmed visual and acoustic records of Big Brown Bats (*Eptesicus fuscus*) from NNPR. The only confirmed occurrences (live captures; n = 8) of this species in the NT, however, are from south of Great Slave Lake (Fig. 3E; Appendix 2).

The Silver-haired Bat was recently (2011) confirmed in the NT at Fort Resolution, based on a photograph that clearly showed a bat with the distinctive silver-tipped pelage of this species (Environment and Natural Resources 2013). There is an unconfirmed acoustic record of this species south of Great Slave Lake (Fig. 3F; Appendix 2).

Records of Hoary Bat in the NT are relatively few, but they are widely distributed in the southern NT. A sighting of a Hoary Bat in 1907 from Fort Resolution is the only recorded observation of this species in the NT; there have been no captures, specimens, or photographs. Confirmed occurrences for Hoary Bat come from acoustic recordings made at 10 locations in NNPR, Fort Simpson, Yellowknife, and near Fort Smith (Fig. 3G; Appendix 2).

There are unconfirmed acoustic and visual records of Eastern Red Bat (*Lasiurus borealis*) in NNPR (Fig. 3H; Appendix 2). There have been no captures, specimens, or photographs to confirm the presence of this species in the NT.

Acoustic recordings confirm that bats of unknown species occur at Sambaa Deh Territorial Park. Many other locations in the NT have no confirmed records of bats, but biologists, naturalists and members of the public have reported seeing bats of unknown species (Fig. 3I; Appendix 2). These unconfirmed locations in the Central Plains include the Liard River Valley, Trout Lake, several locations in the Mackenzie River Valley between Fort Simpson and Fort Providence, and north of the Alberta border. There is an unconfirmed sighting in the Western Mountains at Wrigley. In the Eastern Shield, residents of Lutselk'e have reported seeing bats (Environment and Natural Resources 2013), and Hubert Darrell said he saw ''small dark-brown bats at the Big Fall on Hanbury River. . .in the summer of 1901'' (Preble 1908, p 250).

There have been no reports of bats from the Northern Tundra ecological region of NT.

Maternity Colonies and Hibernacula

Reproductive female Little Brown Myotis were captured in the Western Mountains in NNPR (Lausen and others 2014), in the Central Plains around Kakisa, and in the Fort Smith area (Reimer 2013; JP Reimer, unpubl. data). Three reproductive female Northern Myotis were captured in the Central Plains at Thebacha Cabins (Reimer and Kaupas 2013; JP Reimer, unpubl. data).

There are 3 confirmed Little Brown Myotis maternity colonies in buildings at Kakisa, Lady Evelyn Falls campground, and Thebacha Cabins. There are also unconfirmed reports of groups of bats living in buildings that are possible maternity colonies. These records are from Sandy Lake, Fort Providence, Trout Lake, Spence Creek, and the lower Liard River (Appendix 2). A stand of deciduous trees about 2 km from Thebacha Cabins includes at least 2 maternity roost trees for Northern Myotis (Reimer and Kaupas 2013).

The locations of known or suspected bat hibernacula are considered sensitive by local people and the Government of the Northwest Territories; therefore they are discussed only generally. Approximately 3000 bats overwinter in a karst cave known as the South Slave hibernaculum, and Little Brown Myotis have been confirmed overwintering there. Northern Myotis and Big Brown Bats have been captured entering or leaving in summer, and based on their capture there in September when snow had fallen, may also hibernate there (Appendix 2).

A March 2012 sighting reported near Tulita (Environment and Natural Resources 2013) suggests another possible bat hibernaculum in a region known to have karst topography (Ford 2009). There is an unconfirmed report of approximately 200 bats overwintering in the roof of a cabin near Highway 1, north of the Alberta border. In addition, bats have been reported in late fall in areas that have caves and deep cracks in the ground (Deep Lake area and Trout River; Environment and Natural Resources 2013). Bats have been observed at caves in NNPR (Fenton and others 1973) but the caves have not been surveyed in winter.

DISCUSSION

Distribution of Species

Prior to 2006, 3 species of bats were known to occur in the NT: Little Brown Myotis, Northern Myotis, and Hoary Bat (van Zyll de Jong 1985). Our review is the 1st assessment of bat diversity and distribution in the NT, and we document that there are at least 7, possibly 8, species of bats in the NT, and refine the distribution of those species near the northern limits of their range. Bat surveys, as well as observations of bats reported by NT residents, have added Long-eared Myotis, Long-legged Myotis, Big Brown Bat, and Silver-haired Bat to this list for a total of 7 confirmed species, plus an additional species suspected to occur (Eastern Red Bat).

The Little Brown Myotis is the most common and widely distributed bat species in Canada, with a distribution ranging from Alaska to Mexico (Fenton and Barclay 1980; van Zyll de Jong 1985), and is commonly thought to be the most abundant and widespread bat north of 60°N latitude (van Zyll de Jong 1985; Parker and others 1997; Slough and Jung 2007). The evidence suggests that this is the case in the NT, as there are 969 confirmed captures and specimens of Little Brown Myotis distributed throughout the southwest and south-central

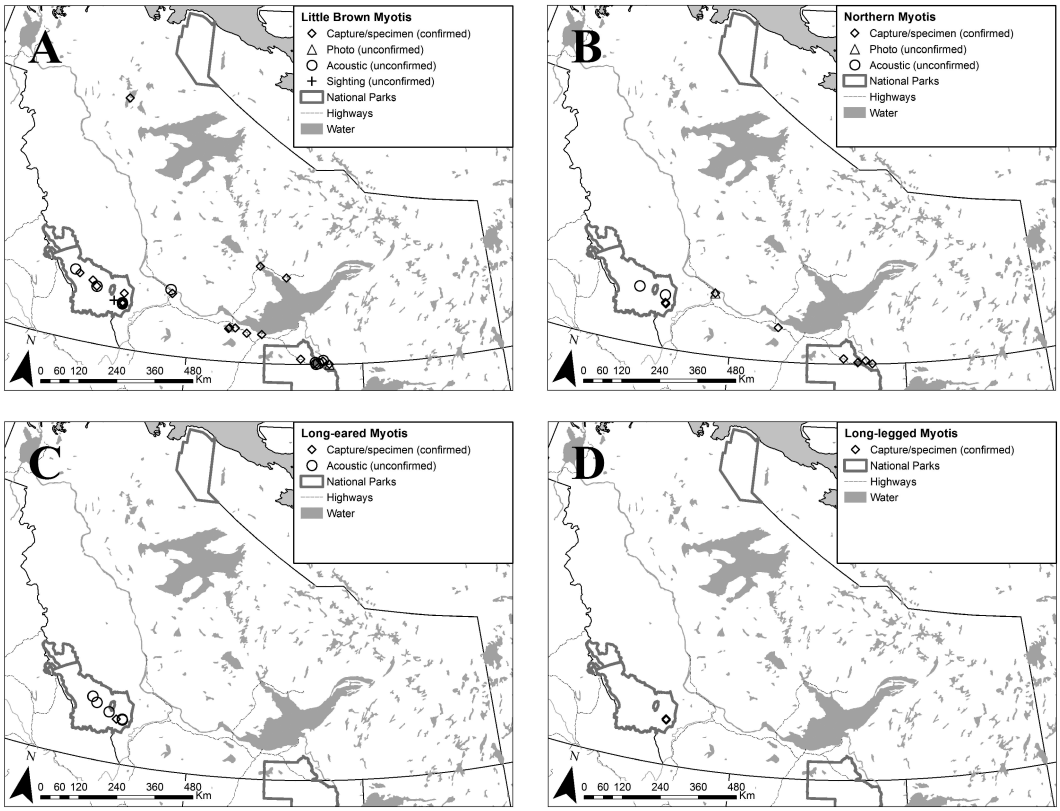

FIGURE 3. Locations of bat species records in the Northwest Territories: (A) Little Brown Myotis (*Myotis lucifugus*)*; (B) Northern Myotis (*Myotis septentrionalis*); (C) Long-eared Myotis (*Myotis evotis*); (D) Long-legged Myotis (*Myotis volans*); (E) Big Brown Bat (*Eptesicus fuscus*); (F) Silver-haired Bat (*Lasionycteris noctivagans*); (G) Hoary Bat (*Lasiurus cinereus*); (H) Eastern Red Bat (*Lasiurus borealis*); (I) unknown species*. * = locations of known or suspected bat hibernacula are considered sensitive and are not shown.

part of the territory (667 from maternity colonies, 226 from a hibernaculum, and 76 from other sites). However, other bat species may be more common or widespread than the data suggest. Larger, high-flying bat species like Big Brown Bat, Hoary Bat, and Eastern Red Bat are less likely to be captured in mist nets compared to *Myotis* species (Patriquin and Barclay 2003; Willis and Brigham 2003), and some species like Hoary Bat are rarely seen, even where they may be common (van Zyll de Jong 1985). The search effort has been biased towards Little Brown Myotis because recent research has targeted this species (Reimer 2013) and they are more likely reported by the public because they often roost in buildings (Fenton and Barclay 1980; Parker and others 1997).

A Little Brown Myotis specimen found at the North Arm of Great Slave Lake in November 2013, and another captured in Yellowknife in October 2005 (Environment and Natural Resources 2013), represent a range extension for this species. The Little Brown Myotis specimen found in Colville Lake (67.03°N, −126.12°W) in October 2012 (Environment and Natural Resources 2013) is the northernmost record of Little Brown Myotis from the NT and, to our knowledge, the northernmost record of any bat species in North America. The lack of other bat records nearby suggests the Colville Lake bat may be extralimital, although unconfirmed reports of bats from Wrigley and near Tulita suggest that the range may extend further north than Fort Simpson (61.86°N) in the Mackenzie River Valley. Other records at the northern distributional limit include: Minto Lake, Alaska (65°N; confirmed Little Brown Myotis); Fort Yukon, Alaska (66.6°N; sight records of unknown

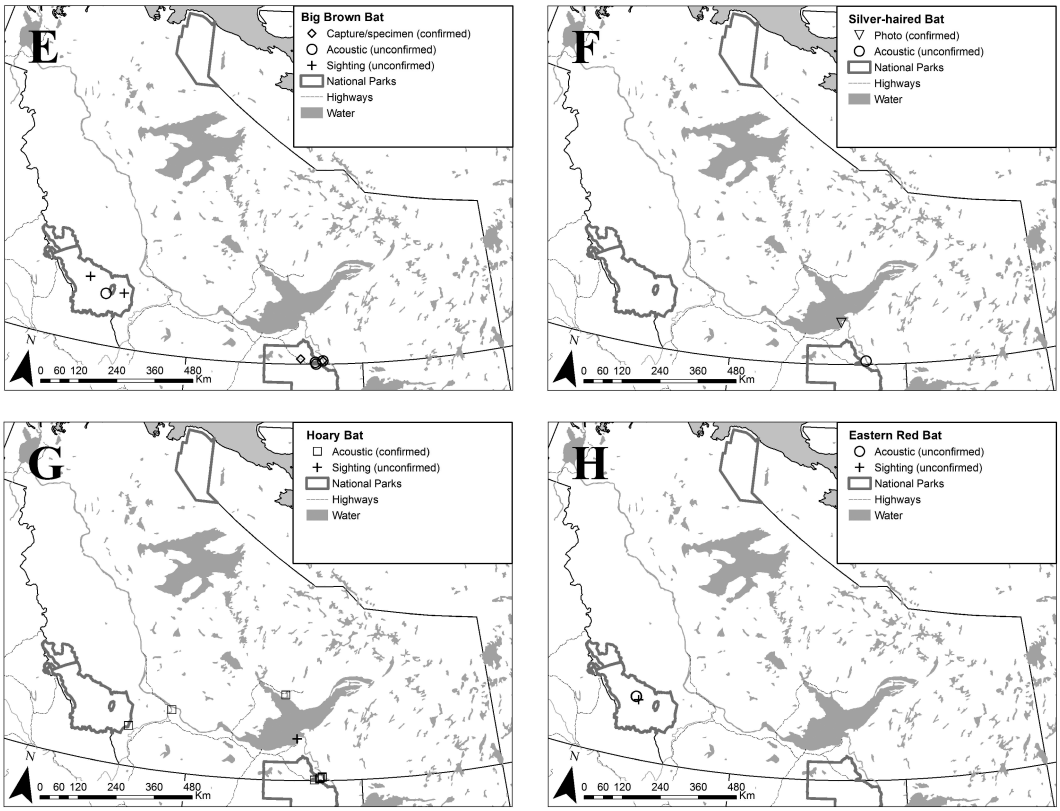

FIGURE 3. Continued.

species); Dawson City, Yukon (64°N; acoustic recordings and incidental observations); and Southampton Island, Nunavut (64°N; Hoary Bat, and Eastern Red Bat specimen CMNMA 27822) (Hitchcock 1943; Parker and others 1997; Anand-Wheeler 2002; Slough and Jung 2008).

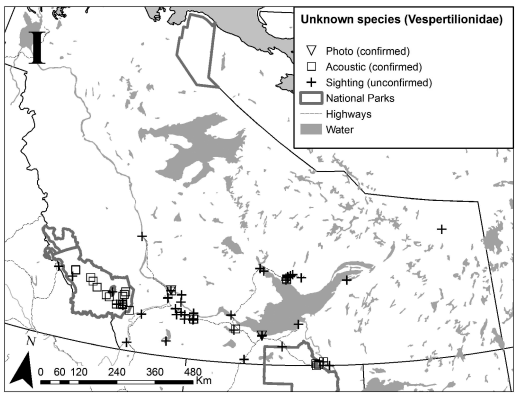

FIGURE 3. Continued.

Northern Myotis is found primarily in forested regions with a distribution across Canada (Caceres and Barclay 2000), including northern BC, northern Alberta, and Yukon (Vonhof and others 1997; Vonhof and Hobson 2001; Jung and others 2006; Grindal and others 2011). Northern Myotis is widely distributed in southern NT with a range similar to that of Little Brown Myotis, and appears to be relatively abundant (109 confirmed captures and specimens). This challenges a commonly held assumption by biologists and the public that *Myotis* bats observed or acoustically recorded in the NT are probably Little Brown Myotis. We suggest that both Little Brown Myotis and Northern Myotis should be considered as possible candidate species for any *Myotis* bat record from anywhere in the NT; and Long-eared Myotis and Long-legged Myotis should also be considered as possible candidate species for any *Myotis* bat record in southwestern NT. These species look very similar, and can usually only be distinguished by an experienced observer after careful examination and measurement of

morphological features (Nagorsen and Brigham 1993).

Long-legged Myotis is distributed from southeastern Alaska through western Canada to Mexico, primarily in coniferous forests (Warner and Czaplewski 1984). Long-eared Myotis is found in a wide variety of habitats from the western Canadian provinces to Baja California and South Dakota (Manning and Knox Jones 1989). The records from NNPR are the northernmost in North America for both Long-legged Myotis (61.28°N, −124.08°W) and Long-eared Myotis (61.24°N, −124.44°W), and are approximately 300 km further north than the rest of the known range (Lausen and others 2014). It is likely that their ranges are continuous and that both species occur south of NNPR.

Our recent work has extended the known range of the Big Brown Bat northward by about 90 km, into the Fort Smith area and the NT portion of Wood Buffalo National Park (WBNP). The capture records combined with numerous acoustic recordings of low-frequency echolocation calls suggest that the Big Brown Bat is common in this area. Although the Big Brown Bat seems to be absent from the area around Fort McMurray, Alberta (Grindal and others 2011; Lausen and Player 2014), it is known from northwest and north-central Alberta (Vonhof and Hobson 2001) and a population of reproducing and hibernating Big Brown Bats has been identified in WBNP, Alberta (van Zyll de Jong 1985; Reimer and others 2014). Sightings and echolocation calls recorded by Lausen and others (2014) suggest that the Big Brown Bat may also be found in the western mountains of NT. Similarly, low-frequency echolocation calls recorded in Yukon (Slough and Jung 2008; Slough and others 2014) and in the Liard River watershed of northeastern BC (Wilkinson and others 1995; Bradbury and others 1997) are suspected to be from Big Brown Bats. However, none of the records in or near southwest NT have been confirmed by a capture or specimen. Targeted sampling might confirm the presence of the Big Brown Bat in the southwest NT.

The Hoary Bat and Silver-haired Bat are migratory species that move southward in fall from summer roosts to winter sites (Kunz 1982; Shump and Shump 1982a; Cryan 2003). Cryan (2003) found that both species showed some range expansion in August and September, perhaps due to breeding activity, population increase following the birth of young, or exploratory migration.

A Silver-haired Bat photographed in Fort Resolution (61.17°N, −113.67°W) in September 2011 (Environment and Natural Resources 2013) is the 1st record of this species from north of 60°N (Parker and others 1997; Yukon Environment 2011) and represents a range extension of about 390 km. The occurrence of this species in NT is further supported by echolocation calls recorded near Fort Smith on both the NT and Alberta sides of the border (Reimer and others 2014; Fig. 3F). There is insufficient information to determine whether Silver-haired Bats occur regularly in the NT or are occasional vagrants. To the south, Silver-haired Bats have previously been captured in northern Alberta around Sousa Creek, Wabasca River, and Fort McMurray (Vonhof and Hobson 2001; Grindal and others 2011), and in northeastern British Columbia in the Liard River drainage northwest of Fort Nelson (Wilkinson and others 1995; Vonhof and Wilkinson 1999).

The Hoary Bat echolocation calls recorded in Yellowknife (62.42°N, −114.42°W) in late August 2011 (Appendix 2) constitute a 150 km range extension for this species. There is 1 record of this species from further north, a 1942 specimen from Southampton Island, Nunavut (64°N; Hitchcock 1943), which was found over 800 km beyond the tree line and is considered extralimital. Anand-Wheeler (2002) mentions a Hoary Bat sighting in Arviat, Nunavut (61.12°N, −94.06°W); Slough and others (2014) recorded Hoary Bat calls along the Smith River, Yukon (60.08°N). Apparent vagrants of this species have occasionally been found as far away as Bermuda, Iceland, and Scotland (Cryan 2003). However, multiple confirmed records from the NT (acoustic recordings from mid-June to late September) suggest that the Hoary Bat occurs regularly in the NT in summer, at least as far north as NNPR, Fort Simpson, and Yellowknife. Additionally, Hoary Bats have been recorded between mid-May and early October in WBNP just south of the NT border (Reimer and others 2014). There is insufficient information to determine whether Hoary Bats are raising young in the NT, or passing through during migration, or whether the NT records

reflect late summer or early fall range expansion. The Hoary Bat is easily detected acoustically (van Zyll de Jong 1985), therefore additional acoustic monitoring in the NT would provide more information on the seasonal occurrence of this species and the northern limits of its range.

It has been suggested that the Eastern Red Bat, another migratory species, may be expanding its range westward (Willis and Brigham 2003; Lausen and Player 2014). Extensive capture records from northeastern Alberta suggest that the Eastern Red Bat is resident there (Grindal and others 2011; Lausen and Player 2014), and this species was recently confirmed in northeastern BC from mortalities at a wind farm (Nagorsen and Paterson 2012). Occurrence of the Eastern Red Bat in NT has not been confirmed, but unconfirmed records from NNPR (Lausen and others 2014) and WBNP, Alberta (Lausen 2011; Reimer and others 2014) suggest that the Eastern Red Bat may occur in NT where suitable habitat can be found (such as relatively large deciduous trees for day roosting and open forest for foraging; Jung and others 1999; Hutchinson and Lacki 2000; Elmore and others 2005). We are aware of only 1 confirmed record of this species from north of 60°N. An Eastern Red Bat collected on Southampton Island, Nunavut, in 1954 (CMNMA 27822), was well beyond tree line and likely a vagrant.

Ecological Regions and Bat Distribution

Bats are confirmed in 3 of 4 ecological regions of mainland NT: Western Mountains, Central Plains, and Eastern Shield (Table 1).

Although bats reach a northern limit of their distribution in the NT, the compiled records suggest that they are not rare in the southern part of the Central Plains. Confirmed records and reported sightings suggest that bats are common at many sites in this region. We suggest that much of the southern Central Plains contains suitable habitat for bats. Gaps in bat occurrences in this region are likely due to gaps in survey effort. For example, the lower Liard River Valley between Nahanni Butte and the British Columbia border supports the most productive forests in the NT including extensive, mature stands of Trembling Aspen, Balsam Poplar, and White Spruce; tree heights can exceed 30 m in older stands, providing many potential natural diurnal roost sites. This area has the warmest climate in the NT (Ecosystem Classification Group 2007 [rev. 2009], 2008). This area has not been surveyed for bats, but it is likely that species diversity is high and could include Long-legged Myotis, Long-eared Myotis, Silver-haired Bat, and Hoary Bat that are found further south in the Liard River Valley (Wilkinson and others 1995; Bradbury and others 1997; Vonhof and others 1997; Vonhof and Wilkinson 1999), as well as Big Brown Bat and Eastern Red Bat whose ranges include northeastern BC (BC Ministry of Environment 2008; Nagorsen and Paterson 2012).

With 5 species confirmed and 2 suspected, NNPR has high bat species diversity relative to other parts of the NT (Lausen and others 2014). It is unknown whether bats occur in the Mackenzie Mountains north of NNPR as this area has not been surveyed for bats. These mountains are ecologically similar to NNPR in many ways, but are generally cooler and have lower tree species diversity, lower tree density and height, and tree line at lower elevations (Ecosystem Classification Group 2010). In the 1980s, approximately 25 bats were observed frozen in a glacier in the Mackenzie Mountains of eastern Yukon (at Keele Peak, 63.27°N, −130.36°W; Slough and Jung 2008), at approximately the same latitude as Wrigley, NT. Slough and Jung (2008) speculated that these bats may have been migrating.

Although range maps for most bat species do not extend into the Eastern Shield (Taiga Shield Ecozone), the range of Little Brown Myotis does so in Nunavut, northern Saskatchewan, Quebec, and Labrador (van Zyll de Jong 1985; Ecological Stratification Working Group 1996; Anand-Wheeler 2002; Naughton 2012). The Eastern Shield region of NT is expected to be less suitable for bats than the Central Plains because its forests are more open and stunted, it warms up later in spring, and it has cooler summers (Bonsal and Prowse 2003; Ecosystem Classification Group 2007 [rev. 2009]). Despite these conditions, there is evidence that some bats do occur in the NT's Eastern Shield. There are bat records from the North Arm of Great Slave Lake, where the Central Plains transitions to the Eastern Shield. The capture and acoustic recordings of bats from Yellowknife (Fig. 3A, 3G, 3I) are the 1st confirmed records of bats in the

Eastern Shield of NT, and they indicate that this ecological region supports some bats. However, bats seem to be much less common than in southern NT and are infrequently observed, at least in the Yellowknife area (JM Wilson, pers. ob.). Reports of bats at Lutselk'e (62.41°N, −110.74°W; Environment and Natural Resources 2013) and Hanbury River (approximately 63.62°N, −104.57°W; Preble 1908) suggest that bats may be found in the Eastern Shield of NT beyond Yellowknife, but this has not been confirmed. These locations are approximately 200 and 500 km further east, respectively, than the nearest confirmed records. Clarke (1940) questioned the Hanbury River sighting because he presumed the environment was unsuitable for bats, but this part of the Eastern Shield features relatively tall and vigorous stands of White Spruce in the river valleys that represent a northward extension of tree line. Many plant and animal species occur in the Hanbury River area well north of their main range (Ecosystem Classification Group 2008; Fig. 1).

It is unknown whether bats occur in the NT north of the tree line. The Northern Tundra has not been surveyed for bats and there is no evidence to suggest they occur there.

Distribution Limits

The distribution of bats in the NT is likely most influenced by roost availability and foraging opportunities. The availability of summer roosts with suitable microclimates is one possible limiting factor. During the summer, *Lasiurus* spp. roost on tree branches among the leaves and prefer densely foliated tree canopies (Shump and Shump 1982a, 1982b; Kunz and Lumsden 2003). *Myotis* spp. as well as Big Brown Bat and Silver-haired Bat roost in natural tree cavities, under loose bark, in rock crevices, in cracks in the ground, and in buildings (Fenton and Barclay 1980; Kunz 1982; Kurta and Baker 1990; Broders and Forbes 2004). Trees that are relatively tall, large, and uncluttered by surrounding vegetation are generally more likely to be selected for tree roosts (Vonhof and Barclay 1996; Kunz and Lumsden 2003). There is very little information specific to the NT on natural roost preferences. A few cases have been observed of individual reproductive female Little Brown Myotis roosting behind sloughing bark of deciduous trees prior to parturition (JP Reimer, unpubl. data), and reproductive female Northern Myotis have been observed roosting in hollow deciduous trees (Reimer and Kaupas 2013). Male and non-reproductive female Little Brown Myotis are known to occasionally use karst caves in WBNP, Alberta, as summer day roosts; echolocation recordings suggest they do the same at the South Slave hibernaculum (Reimer and others 2014).

The latitudinal tree line likely limits bat distribution (Parker and others 1997). Others have found that bat distribution in the north is correlated with the occurrence of forests (Ahlén 1983; Rydell and others 1994), although bats are sometimes found in habitats that lack large trees (Parker and others 1997). At some point south of the tree line, the availability of natural summer roosts for tree cavity-roosting bats could be limited by a lack of tall, large dead trees. This may occur in the Central Plains region, as forests become less dense and trees become smaller moving northward down the Mackenzie Valley (Ecosystem Classification Group 2007 [rev. 2009]). Rock crevices and cracks in the ground would still be available at high latitudes. Artificially heated roosts in buildings would also still be available, though not abundant due to a sparse human population. It has been suggested elsewhere that the use of building roosts is important for bats at the extreme northern limits of their range, especially for reproductive females (Rydell 1989; Rydell and others 1994; Slough and Jung 2008). In the southern NT, reproductive female Little Brown Myotis have been most frequently observed roosting in cabin attics (Reimer 2013), but research has targeted building colonies so the relative importance of natural versus artificial roosts is not known.

The availability of suitable overwintering sites may also limit the distribution of hibernating bat species in the NT. In other parts of their range, Little Brown Myotis, Northern Myotis, Long-eared Myotis, Long-legged Myotis, and Big Brown Bats hibernate in sites with stable cool temperatures such as caves, abandoned mines, or deep rock crevices (Caire and others 1979; Schowalter 1980; Kurta and Baker 1990; Whitaker and Rissler 1992; Caceres and Barclay 2000). Upon spring emergence, individuals perform small-scale migrations (10 to 500 km)

to re-locate to summer roosts (Gifford and Griffin 1960; Fenton 1970; Cryan and others 2001, Perry and Thill 2007; Norquay and others 2013). Very little is known about the winter ecology of bats in northern Canada. Little Brown Myotis have been observed hibernating in the NT south of Great Slave Lake and in WBNP, Alberta (Reimer 2013; Reimer and others 2014). A small number of bats banded in summer have been observed overwintering in hibernacula close to their banding site, suggesting that summer residents over-winter in the area.

Humphries and others (2002) predicted that Little Brown Myotis hibernation had a northern biogeographical limit and should not be possible in the NT. However, there is 1 recently discovered hibernaculum in a karst cave in NT and 1 suspected hibernaculum, suggesting that the northern limit of hibernation is further north than previously supposed. There are many unsurveyed caves and old mines in the Western Mountains and Central Plains regions (Ford 2009; Northwest Territories Geoscience Office 2013), some of which may be bat hibernacula.

Short summers combined with short and cool summer nights may also impose a northern limit on the distribution of bats by limiting their foraging opportunities. The shorter the frost-free season, the shorter the period when flying insect prey are available to bats for growth, reproduction, and accumulation of winter fat reserves. Cool summer nights may also be a limiting factor as cool temperatures inhibit the flight activity of insects (Taylor 1963) and are generally associated with low levels of bat activity (Rydell 1991; Hickey and Fenton 1996; Wilkinson and Barclay 1997). It is not known how warm a night has to be for bats in the NT to forage successfully; however, work in the north has suggested that a threshold temperature for bats to emerge from their roosts may be approximately 5°C (Rydell 1991; Talerico 2008; Reimer 2013). Bats tend to remain nocturnal even when nights are short (Speakman and others 2000; Talerico 2008; Reimer 2013), therefore their distribution may also be constrained by limited periods of darkness in summer.

Reproductive female bats may have a more constrained distribution than other bats because reproductive females tend to need warm environments with high prey availability, whereas others are better able to exploit cool environments and need less food (Thomas 1988; Barclay 1991; Cryan and others 2000). Little Brown Myotis and Northern Myotis are able to reproduce in the NT. Males seem to be more commonly recorded than females at NT sites other than known maternity colonies, but the sex ratio and the ratio of reproductive to non-reproductive females are not known. Further research is needed to better understand the demography of bats living north of 60°N and whether the sexes may have differing distributions.

It is likely that bats reach the northern limit of their Canadian distribution somewhere in the Mackenzie River Valley of the Central Plains ecological region of the NT. In this region, forests extend almost to the Arctic Ocean (Fig. 1) and summer temperatures are warmer than in the Eastern Shield or Western Mountains (Bonsal and Prowse 2003; Ecosystem Classification Group 2007 [rev. 2009], 2008, 2010). Karst topography occurs in and around the valley as far north as 66.5°N (Ford 2009), so deep caves may also be available for possible hibernation habitat. Because there has been no attempt to survey bats north of Fort Simpson, the northern distribution limits are not known. Research in the Mackenzie River Valley toward Great Bear Lake would be needed to determine the northern range limits of bats in the NT.

The state of knowledge on the diversity and distribution of bat species in the north would be improved by summer bat surveys in the Liard River Valley and the Mackenzie River Valley west of Great Slave Lake, including the area north of Fort Simpson. Acoustic bat detectors could be used to investigate the distribution of bats where resources are limited or mist netting is not feasible. Population abundance and trends are also important information for monitoring and managing bats, but these are currently data gaps. Investigating reports that suggest possible bat hibernacula and maternity colonies would be a good step toward identifying sites for long-term population monitoring.

Bat records in the NT date back to the 1800s and early 1900s, indicating that bats are not new to the NT. The recent increase in information on NT bats reflects the increase in interest and search effort. This review provides baseline information that can be improved in the future

and that can be used for comparison when monitoring changes due to climate change, white-nose syndrome, and other factors. Unfortunately, the lack of search effort prior to 2006 limits our ability to detect changes in the distribution of species that may have already occurred. Detailed interviews with local and traditional knowledge holders could help to provide information on the historical distribution and abundance of bats in the NT; thus far, this type of knowledge has not been systematically collected or compiled.

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APPENDIX 1.

Place names in the Northwest Territories, Canada, used in this review and their approximate coordinates. Site numbers correspond to the numbers in Figure 1. Site numbers followed by a letter (such as 2a, 2b) are within 12 km of each other and represented by a single dot on Figure 1.

Areas and sites	Site #	Latitude	Longitude
NAHANNI AREA			
Cantung Mine	1	61.95	−128.26
Hell Roaring	2a	61.97	−127.23
Rabbitkettle	2b	61.96	−127.20
Downriver of Rabbitkettle	3	61.88	−126.91
Flood creek	4	61.84	−126.24
Upriver of Oxbow Lake	5	61.75	−126.07
Oxbow Lake	6a	61.67	−125.89
Virginia Falls	6b	61.61	−125.76
Mary River	7	61.45	−125.13
Prairie Creek Mine	8	61.57	−124.79
The Gate	9	61.41	−124.93
Deadmen Valley	10	61.32	−124.58
Deadmen Valley Warden Station	11a	61.24	−124.44
Near Dry Canyon Creek	11b	61.25	−124.41
Kraus Hot Springs / Hot Springs Cabin	12a	61.26	−124.06
Grotte Andrée	12b	61.31	−124.08
Lafferty Canyon	12c	61.28	−124.08
Near Hole in the Wall Lake	13	61.77	−127.31
The Splits	14	61.13	−123.63
North Karst Ram Plateau	15	61.63	−124.03
North Karst between Death and Moraine lakes	16a	61.49	−124.15
Raven Lake	16b	61.56	−124.07
LIARD RIVER VALLEY			
Lower Liard River	17	61.66	−121.48
Petitot River	18	60.23	−123.47
Blackstone Territorial Park	19	61.09	−122.89
MACKENZIE RIVER VALLEY			
Fort Simpson	20	61.86	−121.35
Wrigley	21	63.27	−123.61
Tulita	22	64.91	−125.69
Spence Creek	23	61.58	−120.68
Highway 1 at 392 km marker	24	61.38	−120.96
Southwest of Jean Marie River	25	61.21	−120.85
Deep Lake area	26	61.11	−120.36
Sambaa Deh Territorial Park	27a	61.14	−119.84
Trout River ~2 km upriver from Sambaa Deh Falls	27b	61.13	−119.83
Trout River ~5 km upriver from Sambaa Deh Falls	27c	61.12	−119.86
Trout Lake (community)	28	60.43	−121.25
Kakisa Lake	29a	60.93	−117.72
Kakisa	29b	60.96	−117.67
Heart Lake forestry tower	30	60.83	−116.65
Lady Evelyn Falls campground	31	60.96	−117.33
Fort Providence	32	61.35	−117.65
SOUTH OF GREAT SLAVE LAKE			
Highway 1, north of Alberta border	33	60.12	−116.73
Hay River	34a	60.81	−115.79
Hay River Reserve	34b	60.83	−115.76
Fort Resolution	35	61.17	−113.67
Point la Presse, Great Slave Lake		Place name not found	
Sandy Lake, WBNP	36	60.53	−114.59
Beaver pond, WBNP	37	60.15	−113.51
Little Buffalo Falls	38a	60.04	−112.71
Little Buffalo Territorial Park	38b	60.06	−112.68
7 Mile Lakeshore	38c	60.00	−112.63

APPENDIX 1. Continued.

Areas and sites	Site #	Latitude	Longitude
Foxhole Road	38d	60.03	−112.50
Confluence of Salt River and Slave River	39a	60.11	−112.23
Thebacha Cabins	39b	60.09	−112.25
Salt River Settlement	39c	60.11	−112.24
Fort Smith	40	60.00	−111.88
South Slave Hibernaculum		Location sensitive	
NORTH OF GREAT SLAVE LAKE			
North Arm	41a	62.75	−116.05
North Arm Territorial Park	41b	62.72	−116.08
Old Fort Rae	42	62.65	−115.83
Yellowknife	43a	62.42	−114.42
Giant Mine	43b	62.50	−114.36
Prelude Lake	44a	62.58	−114.05
Ingraham Trail	44b	62.52	−114.19
Cassidy Point	44c	62.55	−114.18
Pickerel Lake	45	62.49	−113.52
EAST OF GREAT SLAVE LAKE			
Lutselk'e	46	62.41	−110.74
Hanbury River	47	63.62	−104.57
NORTH OF GREAT BEAR LAKE			
Colville Lake	48	67.03	−126.12
Inuvik	49	68.36	−133.72

APPENDIX 2.

Records of bats in the NT, 1833-2013. Age and sex are A = adult; J = juvenile; F = female; M = male. Types of records are S = specimen; C = live capture; A = acoustic recording; P = photograph; V = visual sighting. Site numbers provided in parentheses correspond to Appendix 1 and Figure 1.

Species and Site (Site #)	Date(s)	Number, age, sex	Type	Data sources and notes [a]
LITTLE BROWN MYOTIS				
Deadmen Valley (10)	27 Jun 1970	1	V	15
Grotte Andrée (12b)	1972	≥1	S	7
NNPR (3, 5, 6b, 12a, 12c, 16b)	16 Jul–5 Aug 2006	4 AF; 6 AM	C	9
NNPR (2b, 6b, 12a, 12c)	16–30 Jul 2006		A	9
Fort Simpson (20)	8 Aug 2006		A	9
Fort Simpson (20)	8 Aug 2006	1 JF	S	9
Kakisa (29b)	30 Aug 2011	4 AF; 10 JF; 8 JM	C	11; 12; building maternity colony of >50
Kakisa Lake (29a)	28 Aug 1972	2	S	UAMZ 6933 & 6934
Heart Lake forestry tower (30)	8 Sep 1964	1 M	S	UAMZ 4602
Lady Evelyn Falls (31)	29 Jun–6 Aug 2011	67 AF; 4 AM; 7 JF; 2 JM	C	11; 12; building colony of ~100 AF
Lady Evelyn Falls (31)	15 Jun–7 Aug 2012	116 AF; 7 AM; 2 JF; 1 JM	C	11; 12
Lady Evelyn Falls (31)	24 Jul 2013	18 AF; 2 JF; 4 JM	C	13
Point la Presse, Great Slave Lake	24 Sep 1907	1	S	CMNMA 2387
Hay River (34a)	1908	1	S	1
Beaver pond, WBNP (36)	19 May–27 Aug 2011	3 AF; 23 AM; 5 JF; 4 JM	C	11; 12
Beaver pond, WBNP (36)	15 Aug 2012	4 AM	C	11; 12
Thebacha Cabins (39b)	13 May–2 Sep 2011	89 AF; 12 AM; 22 JF; 12 JM	C	11; 12; building colony of ~400 AF
Thebacha Cabins (39b)	6 Jun–8 Aug 2012	169 AF; 7 AM; 27 JF; 23 JM	C	11; 12
Thebacha Cabins (39b)	21–27 Jul 2013	27 AF; 1 AM; 8 JF; 18 JM	C	13
Little Buffalo Falls (38a)	1 Aug–4 Sep 2011	1 AF; 5 AM; 1 JF; 2 JM	C	11; 12
Little Buffalo Falls (38a)	5 Jun, 12 Aug 2012	1 AF; 3 AM	C	11; 12
Little Buffalo Park (38b)	15 Sep 2010		A	8
Near Fort Smith (38c, 38d, 39a)	15–17 Sep 2010		A	8
Fort Smith (40)	2 Aug 1974	1 M	S	CMNMA 43406
Fort Smith (40)	5 Oct 1974	1	S	CMNMA 43408
Fort Smith (40)	1 Jun, 1 Aug 2011	2	S	5
Fort Smith (40)	24 Aug 2012	1	P	5
South Slave Hibernaculum	15–19 Sep 2010	1 AF; 53 AM; 4 JF; 9 JM	C	8
South Slave Hibernaculum	8 Mar 2011	6 AF; 33 AM	C	6; cave used by ~3000 bats in winter
South Slave Hibernaculum	12 Nov 2011	6 AF; 34 AM	C	12
South Slave Hibernaculum	25 Jul 2012	11 AF; 33 AM	C	12
South Slave Hibernaculum	26 Jul 2013	6 AF; 30 AM	C	13
North Arm (41a)	6 Nov 2013	1 M	S	5; in building
Yellowknife (43)	20 Oct 2005	1 JF	C	5; in building
Colville Lake (48)	3 Oct 2012	1 AF	S	5; in building
NORTHERN MYOTIS				
Kraus Hot Spring (12a)	12 Aug 1974	1 AM	S	3; CN 73581
NNPR (12a, 12c)	29–30 Jul 2006	3 AM	C	9
NNPR (6b, 16a)	23 Jul, 5 Aug 2006		A	9
Fort Simpson (20)	2 Sep 2005	1 F	S	9
Fort Simpson (20)	19 Sep 2007	1	P	5
Lady Evelyn Falls (31)	6 Aug 2011	1 AF	C	12
Lady Evelyn Falls (31)	7 Aug 2012	1 JM	C	12
Lady Evelyn Falls (31)	24 Jul 2013	1 AF	C	13
Great Slave Lake (inferred)	1833–35	1	V	2

APPENDIX 2. Continued.

Species and Site (Site #)	Date(s)	Number, age, sex	Type	Data sources and notes [a]
Beaver pond, WBNP (37)	19 May, 27 Aug 2011	1 AF; 14 AM; 1 JF; 4 JM	C	12
Beaver pond, WBNP (37)	15 Aug 2012	1 AM; 1 JM	C	12
Thebacha Cabins (39b)	17 Jun, 22 Aug 2011	4 AF; 5 AM; 2 JF; 3 JM	C	12
Thebacha Cabins (39b)	7 Jun, 2 Aug 2012	1 AF; 1 JM	C	12
Thebacha Cabins (39b)	21–27 Jul 2013	2 AF; 2 AM	C	13; 2 AF tracked to maternity roosts in trees
Little Buffalo Falls (38a)	1–17 Aug 2011	1 AF; 11 AM; 1 JM	C	12
Little Buffalo Falls (38a)	12 Aug 2012	1 AF; 27 AM; 2 JF	C	12
Fort Smith (40)	27 May–22 Jul 2011	1 AF; 3 AM	C	12
South Slave Hibernaculum	17 Sep 2010	1 AF	C	8
South Slave Hibernaculum	25 Jul 2012	4 AM	C	12
South Slave Hibernaculum	26 Jul 2013	2 AF; 4 AM	C	13
Trail near Hibernaculum	16 Sep 2010	1 AM	C	8
LONG-EARED MYOTIS				
Deadmen Valley Station (11a)	28 Jul 2006	1 AF	C	9
NNPR (5, 6b, 9, 12a, 12c)	21–30 Jul 2006		A	9
LONG-LEGGED MYOTIS				
NNPR (12a, 12c)	29–30 Jul 2006	2 AF; 1 AM	C	9
BIG BROWN BAT				
NNPR (4, 16b)	20 Jul, 3 Aug 2006	2	V	9
Mary River (7)	26 Jul 2006		A	9
Beaver pond, WBNP (37)	11 Jul 2011	2 AM	C	12
Thebacha Cabins (39b)	10 Jul 2012	1 AM	C	12
Thebacha Cabins (39b)	Summer 2011		A	12
Little Buffalo Park (38b)	15 Sep 2010		A	8
7 Mile Lakeshore (38c)	15 Sep 2010		A	8
South Slave Hibernaculum	17 Sep 2010	1 AF	C	8
South Slave Hibernaculum	25 Jul 2012	4 AM	C	12
SILVER-HAIRED BAT				
Fort Resolution (35)	8 Sep 2011	1	P	5
Near Fort Smith (40)	22 Jul 2011		A	12
HOARY BAT				
The Splits (14)	31 Jul 2006		A	9
Fort Simpson (20)	8 Aug 2006		A	9
Fort Resolution (35)	12 Jul 1907	1	V	16
7 locations near Fort Smith (40)	7 Jun–20 Sep 2011		A	12
Yellowknife (43a)	27 Aug 2011		A	18
EASTERN RED BAT				
Upriver of Oxbow Lake (5)	21 Jul 2006		A	9
Oxbow Lake (6a)	3 Sep 2006	1	V	4
UNIDENTIFIED BAT SPECIES				
Cantung Mine (1)	Summer	''bats''	V	5
NNPR (2a, 2b, 4, 6b, 7, 9, 10, 12a, 12c, 14, 15, 16a, 16b)	16 Jul–5 Aug 2006		A	9
Prairie Creek Mine (8)	Summer	''bats''	V	5
Grotte Andrée (12b)	15 Aug 1972	''large amount of activity''	V	7
Near Dry Canyon Creek (11b)	12 Aug 1976	1	V	14
Caves near (12a)	<1973	''bats''	V	7
Near Hole in the Wall Lake (13)	Summer 1960	''bats''	V	5
Lower Liard River (17)	Jul 2012	50–70	V	5; in building
Petitot River (18)		''bats''	V	5
Blackstone Territorial Park (19)	Summer 2006	''many bats''	V	5
Wrigley (21)		''bats''	V	5

APPENDIX 2. Continued.

Species and Site (Site #)	Date(s)	Number, age, sex	Type	Data sources and notes [a]
Near Tulita (approx. 65°N) (22)	Mar 2012	''several''	V	5
Fort Simpson (20)	<1904	''occasionally seen''	V	10
Fort Simpson (20)	8 Aug 2012	1	P	5; in building
Fort Simpson (20)	1–5 Aug 2006		A	9
Spence Creek (23)	~1990s	approximately 5	V	5; in building
Highway 1 at 392 km marker (24)	4 Oct 2013	1	V	5
SW of Jean Marie River (25)	Early spring	''lots of bats''	V	5
Deep Lake area (26)	Nov	1	V	5
Sambaa Deh Park (27a)	10 Aug 2006		A	9
Sambaa Deh Park (27a)	31 Jul 2010		A	18
2 km upriver of Sambaa Deh (27b)	Late fall	''lots of bats''	V	5
5 km upriver of Sambaa Deh (27c)	25 Sep 2004	approximately 15	V	5
Trout Lake (community) (28)		''bats''	V	5; in buildings
6 locations between (20) and (32)	Summer and fall	''lots of bats''	V	5
Kakisa (29b)		''very common''	V	5; in buildings
Lady Evelyn Falls (31)	2012		A	5
Fort Providence (32)	6 Jun 2013	''bats''	V	5; in building
Fort Providence (32)	Late Aug	''swarms – in the tens''	V	5
Highway 1 north of border (33)	Oct 2011	approximately 200	V	5; overwintering in roof
Hay River (34a)	16 Aug 2013	3	P & V	5
Hay River (34a)	22 Sep 2012	1	P	5; in building
Hay River Reserve (34b)	1 Aug 2013	1	V	5; in building
Fort Resolution (35)		''lots of bats''	V	5
Sandy Lake, WBNP (36)	14 Aug 2013	''bats''	V	5; in building
Salt River Settlement (39c)	1933	''several times seen''	V	17
Little Buffalo Park (38b)	15 Sep 2010		A	8
Near Fort Smith (38c, 38d, 39a)	15–17 Sep 2010		A	8
Fort Smith (40)		''common. . . lots of bats''	V	5
South Slave Hibernaculum	8 Mar 2011	2942	V	6
South Slave Hibernaculum	28 Feb 2013	2814	V	6
Old Fort Rae (42)		''lots of bats''	V	5
North Arm Territorial Park (41b)	1993	1	V	5
2 locations in Yellowknife (43a)	27 Jul–7 Sep 2011–12		A	6; 18
3 locations in Yellowknife (43a)	Jul 2000; Jul–Aug 2011–12	1; ''bats''	V	5
3 locations at Giant Mine (43b)	Spring-Aug 2011	2; 1; ''bats''	V	5
Ingraham Trail (44b)	1 Oct 2012	1	V	5
Cassidy Point (44c)	7 Sep 2013	1	V	5
Prelude Lake (44a)	Jun 2011	''at least one''	V	5
Pickerel Lake (45)	2013	1	V	5
Lutselk'e (46)			V	5
Hanbury River (47)	Summer 1901	''bats''	V	10

[a] Data sources: (1) Anderson 1937; (2) Back's Narrative Expedition to Great Fish River 1836 cited in Preble 1908; (3) Carbyn and Patriquin 1976; (4) M Cholo and T Searson pers. comm. cited in Lausen and others 2014; (5) Environment and Natural Resources 2013; (6) Environment and Natural Resources, unpubl. data; (7) Fenton and others 1973; (8) Lausen 2011; (9) Lausen and others 2014; (10) Preble 1908; (11) Reimer 2013; (12) JP Reimer, unpubl. data; (13) Reimer and Kaupas 2013; (14) Scotter and Henry 1977; (15) Scotter and others 1971; (16) Seton 1911; (17) Soper 1942; (18) JM Wilson, unpubl. data. Collections are CMNMA (Canadian Museum of Nature); CN (Royal Ontario Museum); UAMZ (University of Alberta Museum of Zoology).