NRRI Technical Report – 2017

Summary of 2017 Bat Research in Minnesota

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Summary

Bats were captured at 13 study areas across the forested region of Minnesota during June and July 2017 as part of a statewide project focused on northern long-eared bat habitat use. Northern long-eared bats were listed as threatened under the Endangered Species Act in 2015 due to the impacts of White-Nose Syndrome (WNS). Information about the summer roosts these bats use to raise their young will be used to inform future management decisions. Three-hundred fifty bats were captured over 57 nights of mist-netting. Due to low capture rates of northern long-eared bats, VHF transmitters were deployed on adult little brown and big brown bats in addition to northern long-eared bats. We tracked 37 bats to their roosts in 81 trees and six buildings. All bat species roosted in trees of multiple species, varying size, and different decay stages. Colony size ranged from 1 – 45 at tree roosts and from 2 – 450 at building roosts. Fewer northern long-eared bats were captured in 2017 than in previous years, and colony size at northern long-eared bat roosts was also lower than in previous years. These declines are likely the results of WNS mortality. A report summarizing all years of this project (2015 – 2017) will be available in 2018.

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Introduction

White-nose syndrome (WNS) is a fungal disease that has devastated bat populations in the eastern United States, where it was first observed in 2006. WNS has since spread westward, killing more than 5 million bats by 2012 (U.S. Fish and Wildlife Service 2012). The fungus that causes WNS, *Pseudogymnoascus destructans*, thrives in cold humid environments such as the caves and mines that some bats use for hibernation. Bats that are infected with WNS awake more often during hibernation, use up their fat reserves, and then often die of either starvation or exposure to the elements as they search for food in late winter (Frick et al. 2010). In 2013, the fungus that causes WNS was first detected in Minnesota at Soudan Underground Mine, and the first bat mortalities from WNS were observed during the winter of 2015/2016 (Minnesota Department of Natural Resources 2013, 2016).

Eight species of bats have been documented in Minnesota: little brown bats (*Myotis lucifugus*, MYLU), northern long-eared bats (*Myotis septentrionalis*, MYSE), big brown bats (*Eptesicus fuscus*, EPFU), tricolored bats (*Perimyotis subflavus*, PESU), silver-haired bats (*Lasionycteris noctivagans*, LANO), eastern red bats (*Lasiurus borealis*, LABO), hoary bats (*Lasiurus cinereus*, LACI), and evening bats (*Nycticeius humeralis*, NYHU). Four of Minnesota's bat species hibernate in caves and mines and can be affected by WNS: MYSE, MYLU, EPFU, and PESU. The northern long-eared bat experienced especially high mortality rates from WNS in the northeastern U.S., which led to its listing as threatened under the Endangered Species Act in 2015.

In response to this listing, the Minnesota Department of Natural Resources (MN DNR), University of Minnesota Duluth – Natural Resources Research Institute (NRRI), and U.S. Forest Service (USFS), began collaboration in 2015 on a statewide project to study northern long-eared bat summer habitat use, funded by the Environment and Natural Resources Trust Fund (ENRTF). Northern long-eared bats hibernate during the winter, but disperse across the forested region of the state during the summer, foraging on insects at night and roosting in trees during the day. Female bats also give birth and raise their young in these summer roosts, making information on roost selection critical to maintaining high-quality habitat for reproduction.

Data for this project were collected from across the state in 2015 – 2017, including 13 sites in 2017. Results from previous years were summarized in technical reports (Swingen et al. 2015, 2016), and a forthcoming report will summarize results from the entire project (2015-2017). This report summarizes the results from the 2017 field season of the ENRTF-funded project, with support from additional funding sources.

Methods

Bat Capture/Processing

Field crews set up fine mesh mist-nets (Avinet Inc, Dryden, NY, USA) along forested roads, trails, streams, etc. that could act as travel corridors for bats. Each night, 2 – 4 mist-nets were set up within 200 m of a central processing location. We opened mist-nets after sunset, and checked them every 15 minutes for 2 – 5 hours, depending on capture rates and weather conditions.

We identified each captured bat to species, and determined sex, age, and reproductive condition by physical examination. Each bat was also weighed and measured, and the wings were inspected for damage potentially caused by white-nose syndrome (Fig. 1). Wing condition was scored from 0 – 3 according to the Reichard wing-damage index, where 0 indicates no damage and 3 indicates severe damage (Reichard and Kunz 2009). We then fitted each bat with an individually-numbered lipped aluminum wing band (Porzana Ltd., Icklesham, United Kingdom).

Figure 1. Photos showing the techniques for capturing and processing bats. Photo Credits: A – Superior National Forest; B – Brian Houck, NRRI; C – Peter Kienzler, NRRI, D – Christi Spak, MN DNR; E – Ryan Pennesi, USFS; F – Nancy Dietz, MN DNR - CRTC.

A: Mist-nets are raised on poles with a pulley system

B: A bat flies into the mist-net and is caught

C: Bats are handled with disposable nitrile gloves to prevent spread of WNS between bats

D: The wings are examined for damage consistent with WNS

E: A numbered band is attached to the forearm

F: A small transmitter is glued to the skin of the bat using surgical adhesive

Field crews attached radiotransmitters (A2414 Advanced Telemetry Systems Inc., Isanti, MN; or LB-2X, Holohil Systems Ltd., Carp, ON, Canada) to selected adult bats. At the beginning of the summer, we limited transmitter attachment to adult female northern long-eared bats and added other species and sexes later in the season as we assessed capture success. We trimmed a section of hair in the center of the back, and used surgical adhesive (Perma-Type, Permatype Company Inc., Plainville, CT, USA) to attach the transmitter to the skin (Fig. 1). We released all bats at the capture site after processing.

Tracking/Roost Tree Characterization

We tracked bats with radiotransmitters daily to their roosts using radio telemetry until the transmitter failed or fell off. Data recorded at each roost included roost type, tree species, and decay stage. At dusk, crews returned to the roost trees to conduct emergence surveys. During an emergence survey, personnel watched the roost tree from 30 minutes before sunset to 1 hour after sunset. During the survey we recorded the number of bats emerging during each 10-minute interval, the location of the exit point, and whether or not the transmitter left the tree.

Crews returned to each roost tree to conduct a more detailed tree characterization after bats left. This included measuring roost diameter at breast height (dbh), tree height, decay stage, canopy closure, slope, aspect, and recording details about the vegetation surrounding the roost tree.

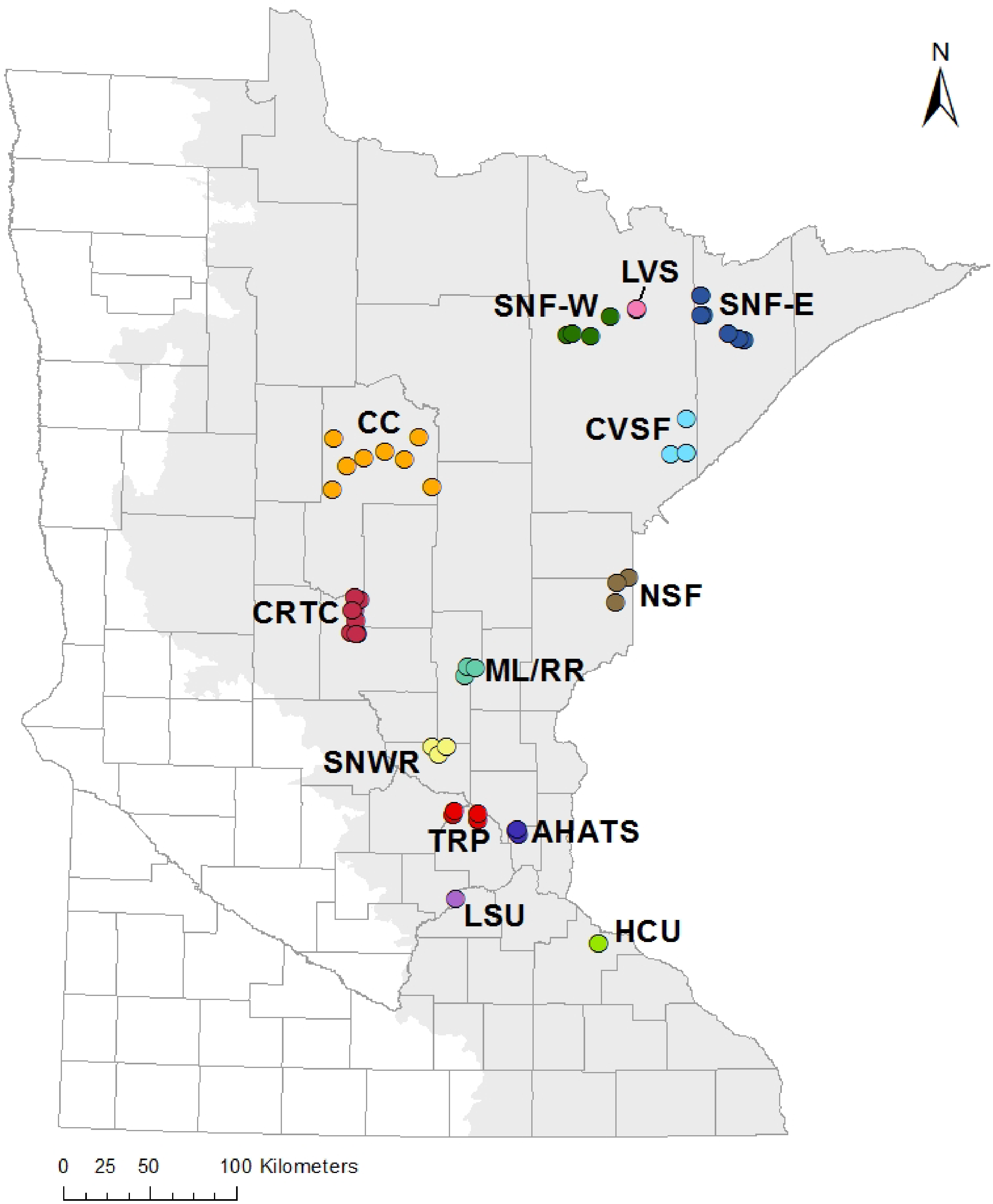
Study Area

We captured bats with mist-nets at 53 sites grouped into 13 study areas throughout the forested region of the state of Minnesota (Table 1, Fig. 2).

Table 1. Names and abbreviations of study areas and dates during which bat mist-netting took place during the 2017 field season.

Study Area Name	Abbreviation	MN County(ies)	Ownership	Date Range
Arden Hills Army Training Site	AHATS	Ramsey	Federal	7/5 – 7/8
Camp Ripley Training Center	CRTC	Morrison	State	6/5 – 6/26
Cass County Sites – Chippewa National Forest, Cass County Forest, & Land O'Lakes State Forest	CC	Cass	County	7/17 – 7/26
Cloquet Valley State Forest	CVSF	St. Louis	State/County	6/5 – 6/8
Hay Creek Unit – Richard J. Dorer State Forest	HCU	Goodhue	State	6/5 – 6/6
Lake Vermilion – Soudan Underground Mine State Park	LVS	St. Louis	State	6/20 – 6/22
Louisville Swamp Unit – Minnesota Valley National Wildlife Refuge	LSU	Scott	Federal	6/19
Mille Lacs Wildlife Management Area/Rum River State Forest	ML/RR	Mille Lacs, Kannabec	State	6/12 – 6/15
Nemadji State Forest	NSF	Pine	State	7/18 – 7/20
Sherburne National Wildlife Refuge	SNWR	Sherburne	Federal	7/5 – 7/8
Three Rivers Park District – Crow-Hassan and Elm Creek Park Reserves	TRP	Hennepin	Three Rivers Park District	6/25 – 6/28
Superior National Forest – West (Laurentian Ranger District)	SNF-W	St. Louis	Federal	6/19 – 6/29
Superior National Forest – East (Kawishiwi and Tofte Ranger Districts)	SNF-E	Lake	Federal	6/12 – 7/13

Figure 2. Map of all 2017 mist-netting locations within the forested region (shaded) of Minnesota. Each dot represents a separate mist-netting site. Mist-netting sites were grouped into “study areas” and are labeled with abbrevations as listed in Table 1.



Results

Mist-Netting

We conducted 57 nights of mist-netting between June 5th and July 27th, 2017, with multiple crews operating simultaneously across the state. Mist-netting took place for 1 – 9 nights at each study area.

Species Captured

We captured and processed 350 bats over 817 net-hours (Fig. 3). We captured individuals of six of the eight bat species recorded in Minnesota (Fig. 4, Table 2). Tricolored bats and evening bats were not captured in 2017.

Figure 3. Map of bat mist-netting capture results in 2017 for all species. Capture results are displayed by study area as listed in Table 1. The size of the symbol at each study area represents the total capture rate (bats/net-hour), and the label at each study area indicates the total number of individuals captured. Note that the high capture rate at one site in St. Louis County was likely due to the proximity to Soudan Mine (within 1 km of mine entrances), which is the largest known hibernaculum in the state.

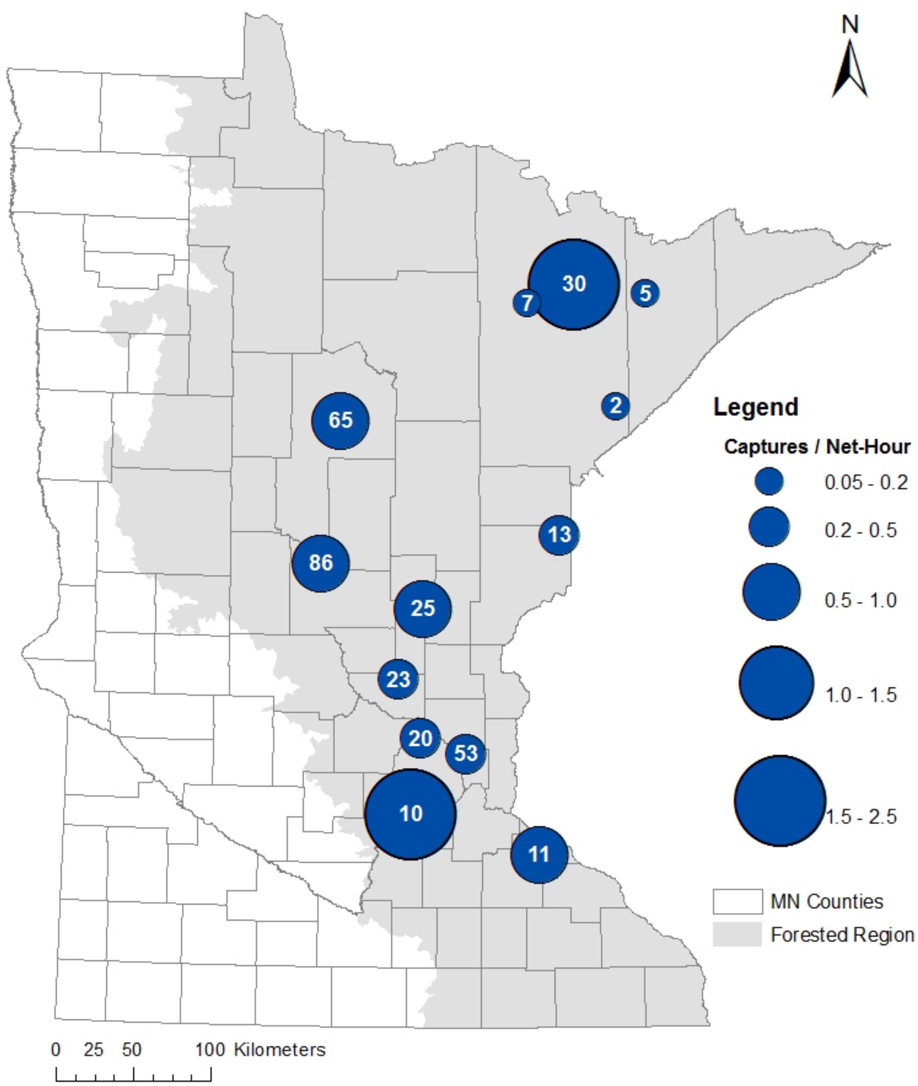


Figure 4. Maps of bat mist-netting results (captures per 10 net-hours) by species in 2017. Capture results are displayed by study area as shown in Figure 2 and listed in Table 1. See Table 2 for total captures by species.

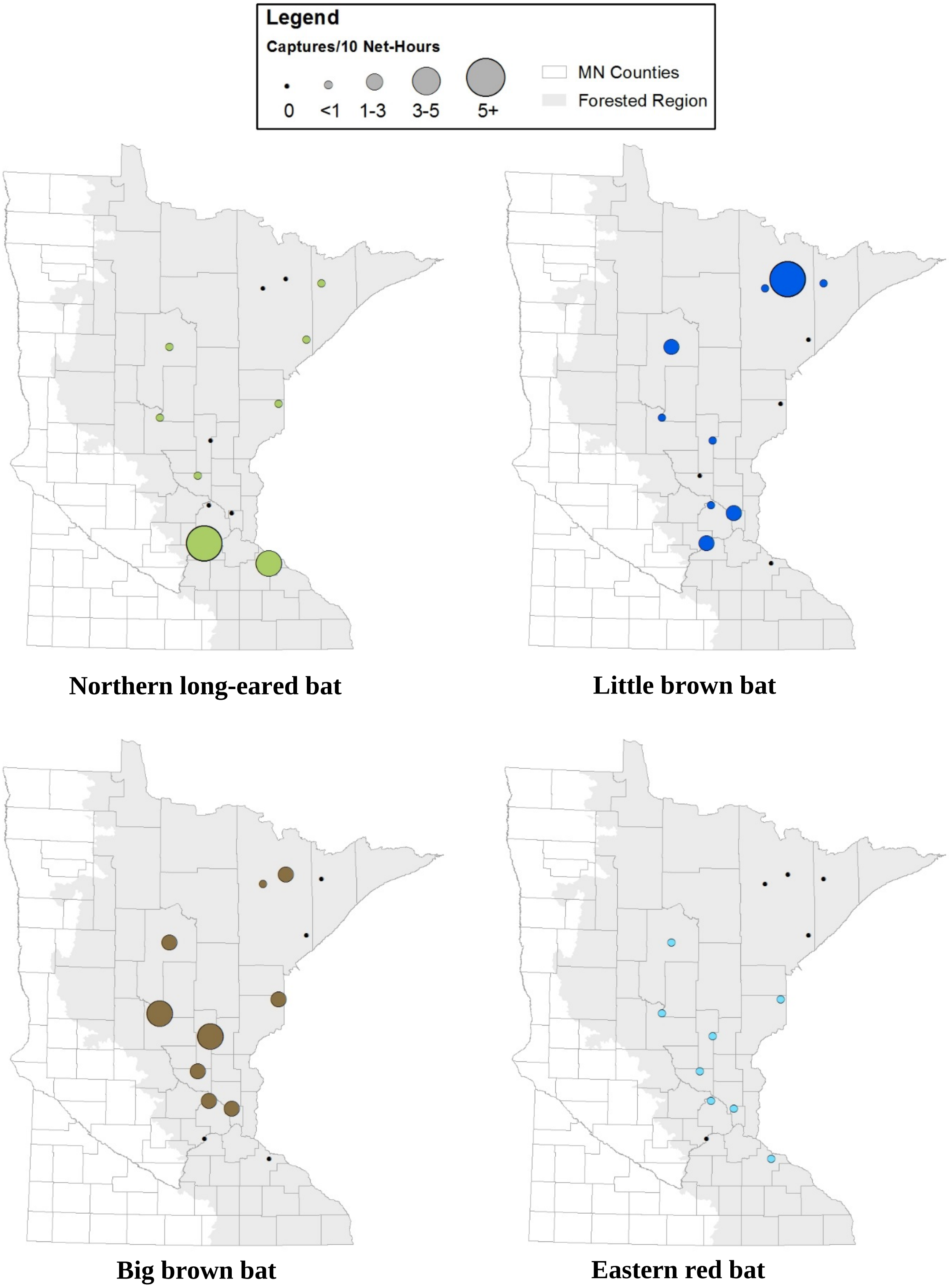
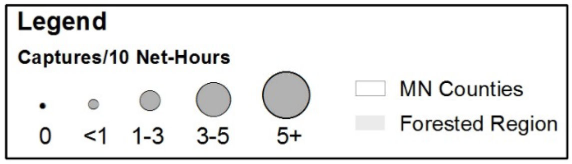
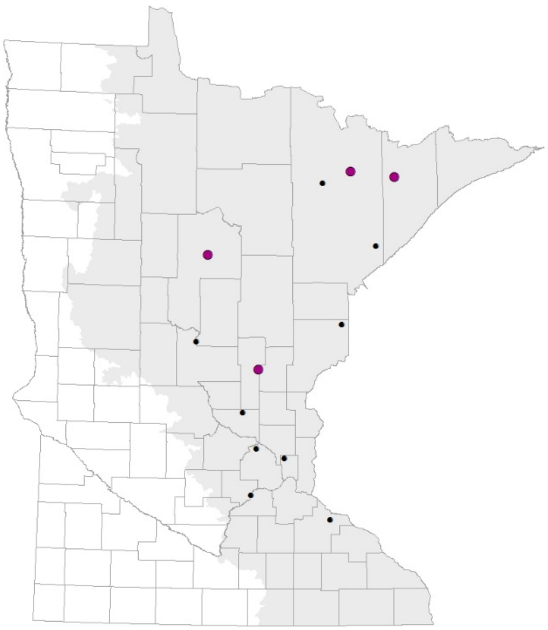
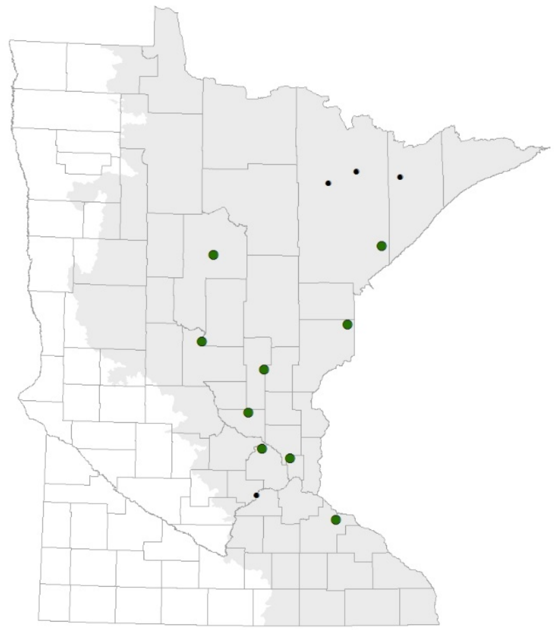


Figure 4 (cont.) Maps of bat mist-netting results (captures per 10 net-hours) by species in 2017. Capture results are displayed by study area shown in Figure 2 and listed in Table 1. See Table 2 for total captures by species.

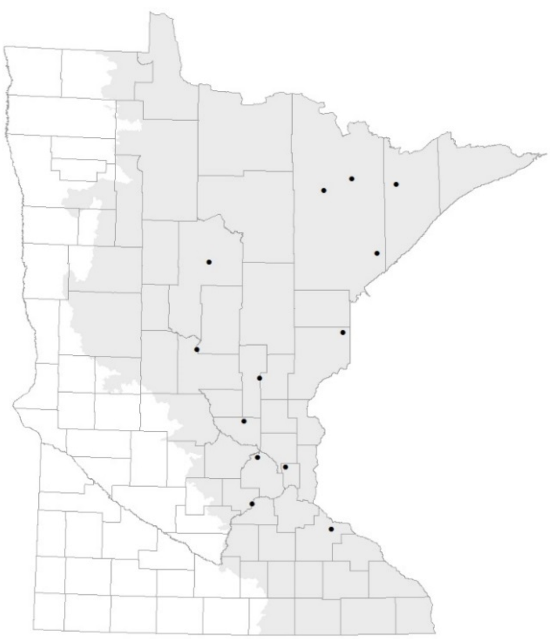




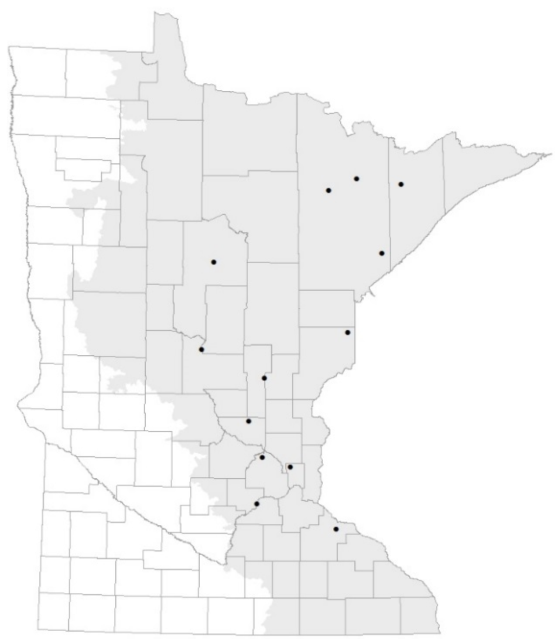
Hoary bat



Silver-haired bat



Evening bat



Tricolored bat

Table 2. Count of bats captured and processed during the 2017 field season by species and sex. EPFU – big brown bat, LABO – eastern red bat, LACI – hoary bat, LANO – silver-haired bat, MYLU – little brown bat, MYSE – northern long-eared bat, NYHU – evening bat, PESU – tricolored bat.

	Species Code								
Sex	**EPFU**	**LABO**	**LACI**	**LANO**	**MYLU**	**MYSE**	**NYHU**	**PESU**	**Total**
Female	73	21	1	25	35	24	0	0	**179**
Male	83	12	3	12	53	8	0	0	**171**
Total	**156**	**33**	**4**	**37**	**88**	**32**	**0**	**0**	**350**

Age Class and Reproductive Status of Captured Bats

Most bats captured were adults, but 46 juveniles were also captured, with the earliest juveniles captured (EPFU and LANO) on July 5th at AHATS. The first juvenile *Myotis* spp. was a MYLU captured on July 6th at AHATS. Most captured female bats were pregnant or lactating, with the first lactating bat captured on June 13th (EPFU) at CRTC and the first lactating *Myotis* spp. captured on June 20th at LVS (Table 3).

Table 3. Number of individual bats captured of all species by age and reproductive condition by week. P – Pregnant, L – Lactating, PL – Post-lactating, TD – Testes descended, NR – Non-reproductive, U – Undetermined. This table only includes those bats for which the reproductive assessment had medium or high confidence.

		Adult Female					**Adult Male**			**Juvenile**	**Total Bats**
Week of Capture	**Net-Hours**	**P**	**L**	**PL**	**NR**	**U**	**TD**	**NR**	**U**	**NR**	
6/5 – 6/11	137	28	0	0	0	6	1	17	3	0	**55**
6/12 – 6/18	104	16	2	0	2	0	1	22	0	0	**43**
6/19 – 6/25	102	7	11	0	2	6	1	28	3	0	**58**
6/26 – 7/2	108	6	11	0	2	0	1	16	0	0	**36**
7/3 – 7/9	178	6	28	0	1	1	3	13	0	23	**75**
7/10 – 7/16	37	0	0	0	0	0	0	2	0	0	**2**
7/17 – 7/23	97	4	3	5	2	0	5	9	0	8	**36**
7/24 – 7/28	56	0	3	2	2	0	9	8	0	14	**38**
Total	**817**	**67**	**58**	**7**	**11**	**13**	**21**	**115**	**6**	**45**	**343**

Wing Damage of Captured Bats

Wing scores of 1 or higher were recorded for 238 of the 350 bats captured (68%), including individuals of all six species captured. Moderate (wing score = 2) damage was recorded for 7% of cave-hibernating bats (EPFU, MYLU, & MYSE) captured, but only one bat showed severe (wing score = 3) damage. The moderate and severe wing damage we observed was likely caused by WNS, although damage alone does not confirm infection.

Radiotransmittered Bats

Our original goal was to deploy transmitters only on reproductive female MYSE, but due to low capture rates in 2017 we began attaching transmitters to female and male MYSE, MYLU, and EPFU. We attached transmitters to 44 bats, including 20 female MYSE (Table 4). The bats were tracked until the transmitters failed or fell off, which was between 1 – 31 days (median = 6).

Table 4. Count of bats which were given transmitters in 2017 by species, sex, and reproductive condition. EPFU – big brown bat, MYLU – little brown bat, MYSE – northern long-eared bat.

		Species Code			
Sex	**Reproductive Condition**	**EPFU**	**MYLU**	**MYSE**	**Total**
Female	Pregnant	3	4	7	14
	Lactating	4	5	3	12
	Post-Lactating	1	0	1	2
	Non-Reproductive	0	2	1	3
	Undetermined	0	0	8	8
Male	Testes Descended	0	0	2	2
	Non-Reproductive	1	2	0	3
Total		**9**	**13**	**22**	**44**

Roost Trees

We tracked 19 MYSE, 10 MYLU, and 8 EPFU to their roosts in 81 trees and six buildings. Seven of the bats originally given transmitters could not be relocated after release. The 19 MYSE were tracked to 56 unique roost trees of at least 17 species (advanced decay of some trees did not allow for identification to species), and one roost in a building. The 10 MYLU were tracked to 12 roost trees of at least four species, and three roosts in buildings. The eight EPFU were tracked to 13 roost trees of at least seven species, and two roosts in buildings. See Appendix A for a full list of tree species used as roost trees in 2017. All bats with transmitters that roosted in buildings were females. For those bats which were tracked to at least one roost, we identified an average of 2.8 roosts per bat.

The roost trees varied from 12 – 72 cm in diameter at breast height (DBH), with an average DBH of 38 cm (Table 5, Fig. 5). Roosts were located in both live trees and dead trees of varying decay stage (Figs. 6,7,8,9). Roost tree height ranged from 4 – 30 m (average 15 m).

Table 5. Characteristics of tree roosts used by bats in 2017, by bat species and sex. Each cell shows the average value followed by the range in parentheses (if applicable). N = number of roost trees identified.

Bat Species/Sex	**N**	**DBH (cm)**	**Decay Class**	**Height (m)**
EPFU / Female	12	34.7 (13.6 – 53.0)	3.6 (1 – 7)	14.4 (4.6 – 21.8)
EPFU / Male	1	51.8	2.0	23.6
MYLU / Female	5	41.3 (24.3 – 66.0)	1.8 (1 – 2)	13.8 (7.2 – 18.6)
MYLU / Male	7	25.4 (16.3 – 37.2)	4.6 (1 – 6)	10.0 (6.0 – 15.2)
MYSE / Female	53	39.3 (11.5 – 71.9)	2.7 (1 – 7)	16.7 (3.8 – 30.5)
MYSE / Male	3	34.2 (32.8 – 35.3)	3.3 (1 – 6)	6.7 (4.9 – 9.5)
Overall	**81**	**37.5 (11.5 – 71.9)**	**2.95 (1 – 7)**	**15.3 (3.8 – 30.5)**

Figure 5. Frequency distribution of the DBH (diameter at breast height) of bat roost trees identified in 2017 (n = 81).

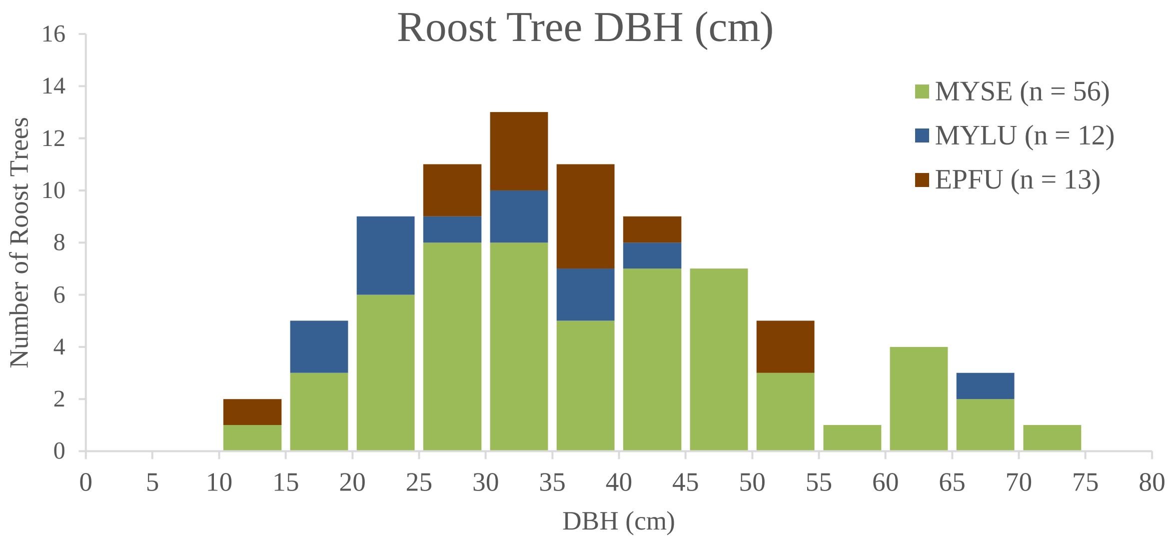


Figure 6. Histogram showing the decay stage of 81 bat roost trees identified in Minnesota in 2017.

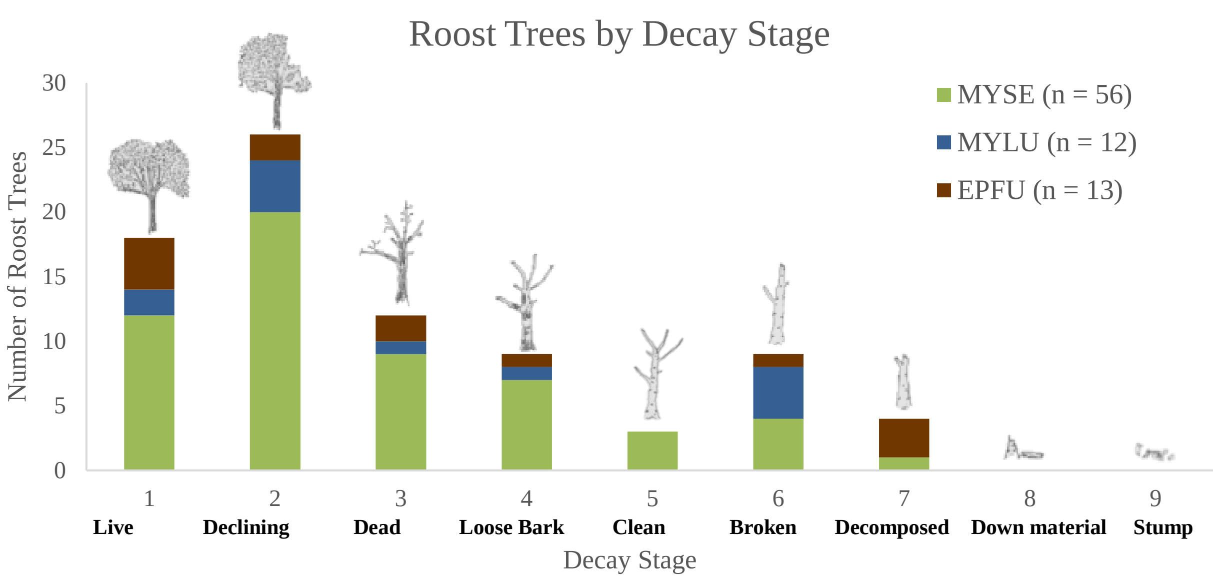


Figure 7. Photos of female northern long-eared bat roost trees identified in 2017. Top row left to right: American elm (*Ulmus americana)* snag in Hay Creek Unit, live paper birch (*Betula papyrifera*) at Camp Ripley Training Center, green ash (*Fraxinus pennsylvanica*) snag at Camp Ripley Training Center, live red pine (*Pinus resinosa*) at Camp Ripley Training Center, live trembling aspen (*Populus tremuloides*) in Cloquet Valley State Forest, and live sugar maple (*Acer saccharum*) in Hay Creek Unit.

Figure 8. Photos of big brown bat roost trees of various species and decay stages identified in 2017. From left to right: bigtooth aspen (*Populus grandidentata*) snag in the Chippewa National Forest, live red cedar (*Juniperus virginiana*) in Three Rivers Park District, and bur oak (*Quercus macrocarpa*) snag on Cass County land.

Figure 9. Photos of little brown bat roosts of various species and decay stages identified in 2017. From left to right: *Populus* spp. snag in the Superior National Forest, live green ash (*Fraxinus pennsylvanica*) in Three Rivers Park District, and trembling aspen (*Populus tremuloides*) snag with broken/hanging top in the Chippewa National Forest.

Movements

The 18 female MYSE that were successfully tracked spent an average of 1.5 days (maximum = 5 days) in each roost (of those roosting events with known start and end dates, n =33). Female big brown bats spent an average of 1.3 days in each roost (n = 7 roosting events of known length), and male little brown bats spent an average of 1.6 days in each roost (n = 18 roosting events of known length). There were less than three roosting events of known length for male big brown bats, female little brown bats, and male northern long-eared bats.

The average distance from the capture (foraging) location to the first roost for all bats was 922 m, and was similar for females (936 m) and males (809 m). EPFU traveled farther on average than MYLU and MYSE from the capture location to their first roost (Table 6). Distance traveled between consecutive roosts for all bats averaged 296 m, with 80% of consecutive roosts < 500 m apart. A male MYSE had the farthest recorded distance between consecutive roosts at 2193 m (Table 7). Three bats with transmitters (one male MYLU, one MYLU female, and one EPFU female) re-used roosts on non-consecutive days within the tracking period (e.g. moved from roost A on day 1 to roost B on day 2 and then back to roost A on day 3).

Table 6. Distances traveled (in meters) between the capture location and the first roost by bats with radiotransmitters in 2017. Each cell shows the average distance followed by the range in parentheses.

Sex	EPFU	MYLU	MYSE	Overall Average
Female	1456 (565 – 3234)	1160 (259 – 2199)	635 (80 – 1380)	936 (80 – 3234)
Male	684	1246 (232 – 2261)	59	809 (59 – 2261)
Overall Average	1360 (565 – 3234)	1177 (232 – 2261)	604 (59 – 1380)	922 (59 – 3234)

Table 7. Distances traveled (in meters) between consecutive roosts by bats with radiotransmitters in 2017. Each cell shows the average distance followed by the range in parentheses.

Sex	EPFU	MYLU	MYSE	Overall Average
Female	317 (33 – 555)	36 (4 – 101)	300 (2 – 1013)	290 (2 – 1013)
Male	-	244 (14 – 416)	739 (12 – 2193)	314 (12 – 2193)
Overall Average	317 (33 – 555)	214 (4 – 416)	325 (2 – 2193)	296 (2 – 2193)

Emergence Surveys

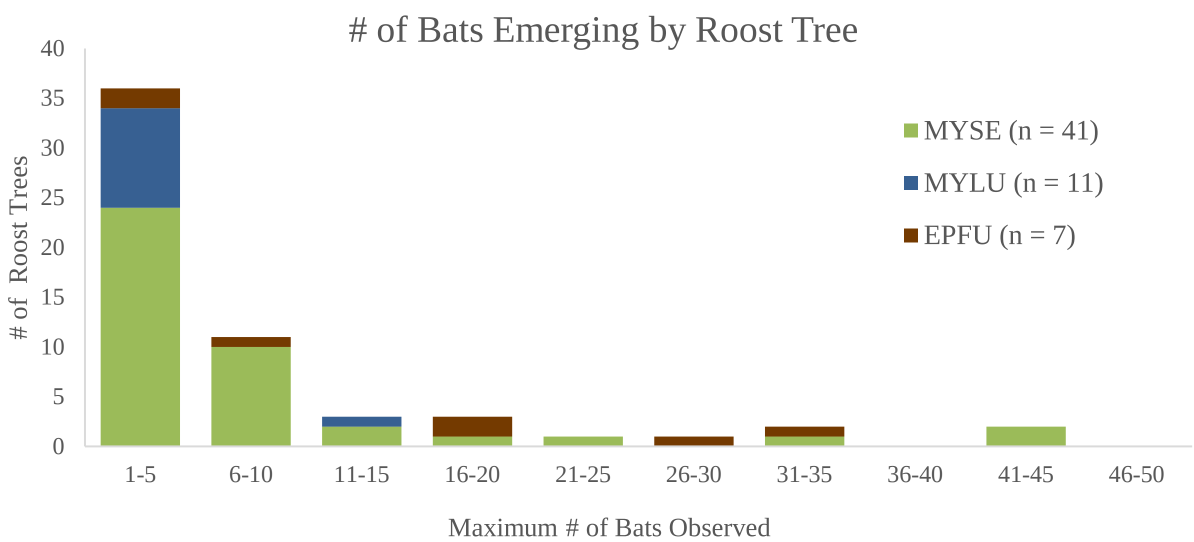
Field crews conducted 70 emergence surveys on 46 of the identified female northern long-eared bat roost trees. Bats were observed exiting the roost in 59 of those surveys. Colony size (total count of bats during one survey) at female northern long-eared bat tree roosts ranged from 1 – 45 and averaged 6.9 (Table 8). Bats were not observed at seven female northern long-eared bat roost trees, which was due to vegetation obstructing the view, misidentification of the roost tree, weather conditions affecting the emergence behavior of the bats, or the maternity colony having moved to another tree (this sometimes occurred if the transmitter had fallen off of the bat in a previously used roost tree).

We also conducted emergence surveys at 23 other identified roost trees used by male northern long-eared bats, and male and female little brown bats and big brown bats. Colony size at roost trees used by female bats was greater on average than colony size at roost trees used by male bats (Table 8).

Table 8. Emergence survey results at tree roosts surveyed in 2017, by bat species and sex. If a roost was surveyed multiple times, the maximum number of bats exiting among all surveys was used to calculate the average colony size across trees. Colony sizes reported here are only for those trees at which bats were observed during emergence surveys (n = 59). Building roosts were not included for this table.

Bat Species	Bat Sex	# Total Surveys	# Roosts Surveyed	# Roosts with Bat Observations	Minimum Colony Size	Maximum Colony Size	Mean Colony Size
MYSE	F	70	46	39	1	45	8.2
MYSE	M	5	3	2	1	3	2.0
MYLU	F	9	4	4	2	13	5.5
MYLU	M	12	7	7	1	5	1.6
EPFU	F	9	8	7	2	34	16.1
EPFU	M	1	1	0	-	-	-

Figure 10. Maximum number of bats observed exiting surveyed roost trees in 2017. If a roost was surveyed multiple times, the maximum number of bats exiting among all surveys is displayed in the figure so that each surveyed roost tree at which bats were observed appears once (n = 59). Emergence counts at roosts in buildings are not included in this chart.



We conducted three surveys of the one building used as a roost by a female northern long-eared bat and observed 3 – 5 bats emerging. At the three buildings used as roosts by female little brown bats, crews observed between 2 – 480 emerging (average = 183). At the two buildings used as roosts by big brown bats, we observed 44 – 96 bats emerging (average = 70).

Discussion

Northern long-eared bat capture rates in 2017 (0.04 bats/net-hour) were lower than capture rates for MYSE in 2016 (0.11) and 2015 (0.15). Average colony size at female MYSE roost trees (8.2) was lower than in previous years as well (2016 = 16.4, 2015 = 21.5). Although many factors can influence capture rates, we suspect these declines are primarily a result of mortality from WNS observed during the winters of 2015/2016 and 2016/2017 (Minnesota Department of Natural Resources 2016, 2017). At the Soudan Underground Mine, which is the largest known hibernaculum in the state, winter counts of hibernating bats in early 2017 were down 73% from the previous year (Minnesota Department of Natural Resources 2017). Also noteworthy was that zero northern long-eared bats were observed during 2016/2017 winter surveys of the Soudan Underground Mine (G. Nordquist, pers. comm.).

The proportion of bats with wing damage scores ≥ 1 (“light” damage or greater) was also greater in 2017 (68%) than in 2015 and 2016 (38% and 41%, respectively). Wing damage does not confirm WNS, but *P. destructans* infection is known to cause lesions and loss of wing tissue (Reichard and Kunz 2009, Cryan et al. 2010). Thirty-six of the 238 bats with wing damage scores ≥ 1 were migratory species (LABO, LACI and LANO) not known to be affected by WNS, although none of these bats were given wing scores of 2 or 3. Minor wing damage in migratory bats unrelated to WNS has also been observed in the eastern U.S. and highlights the importance of lab testing to confirm WNS infection (Francl et al. 2011). Results are pending from laboratory tests of swabs collected from a subset of bats captured in this project.

Our 2017 field season added 5 new tree species to the existing list of tree species used as roosts by female northern long-eared bats, now totaling 27 species. New tree species documented as roosts in 2017 included box elder (*Acer negundo*), silver maple (*Acer saccharinum*), hackberry (*Celtis occidentalis*), black cherry (*Prunus serotina*), and northern pin oak (*Quercus ellipsoidalis*). This lends greater support to the hypothesis that tree species may not be as important to roost selection as other factors such as availability of cavities, cracks, and loose bark (Boyles 2007, Henderson and Broders 2008).

As observed in past years, female northern long-eared bats switched roosts often. The average roosting duration in 2017 (1.45 days) was similar to that observed in 2015 and 2016 (1.33 and 1.25 days, respectively). These durations are also similar to roosting durations reported in Nova Scotia, Michigan, and West Virginia (Foster and Kurta 1999, Johnson et al. 2009, Patriquin et al. 2010), but shorter than durations reported in West Virginia and the Black Hills of South Dakota (Cryan et al. 2001, Menzel et al. 2002).

The 2017 season also allowed us to collect roosting data from other bats that can be affected by WNS, including male MYSE, and male and female MYLU and EPFU. We did not observe strong preferences in any of these groups for certain tree species, tree sizes, or decay classes although sample size was small. EPFU and MYLU tended to roost in cavities and crevices, as observed in other studies (e.g. Brigham 1991, Kalcounis and Brigham 1998, Agosta 2002, Broders and Forbes 2004, Fabianek et al. 2015). MYSE also roosted in cavities and crevices, as well as under loose bark, which has been commonly reported for this species (Broders and Forbes 2004, Perry and Thill 2007, Timpone et al. 2010).

Under the Endangered Species Act, there are tree harvest restrictions within 150 ft of known, occupied northern long-eared bat maternity roost trees in June and July. For more details on these restrictions, see the U.S. Fish and Wildlife Service website (https://www.fws.gov/Midwest/endangered/mammals/nleb/index.html). We intend to use the data collected in this project to inform future management decisions regarding the northern long-eared bat as WNS continues to spread across the United States.

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Appendix A. Number of Identified Roosts by Tree Species

Table of bat roost trees identified in 2017 by tree species and bat species. Some roost trees were not identifiable to species due to advanced decay. Six roosts not included below were located in buildings.

		# of Unique Roosts			
Tree Species Latin Name	**Common Name**	**EPFU**	**MYLU**	**MYSE**	**Total**
Populus tremuloides	Quaking/trembling aspen	2	5	9	16
Quercus alba	White oak	0	0	7	7
Acer saccharum	Sugar maple	0	0	6	6
Quercus rubra	Northern red oak	0	0	6	6
Unknown	Unknown	3	1	2	6
Ulmus americana	American elm	0	0	5	5
Acer rubrum	Red maple	0	1	3	4
Populus grandidentata	Big-tooth aspen	1	0	3	4
Tilia americana	Basswood	1	1	2	4
Betula papyrifera	Paper birch	0	0	3	3
Fraxinus pennsylvanica	Green ash	1	1	1	3
Populus spp.	Aspen (species unknown)	2	1	0	3
Acer negundo	Box elder	1	0	1	2
Celtis occidentalis	Hackberry	0	0	2	2
Fraxinus nigra	Black ash	0	2	0	2
Acer saccharinum	Silver Maple	0	0	1	1
Acer spp.	Maple (species unknown)	0	0	1	1
Juniperus virginiana	Eastern red cedar	1	0	0	1
Pinus resinosa	Red pine	0	0	1	1
Prunus serotina	Black cherry	0	0	1	1
Quercus ellipsoidalis	Northern pin oak	0	0	1	1
Quercus macrocarpa	Bur oak	1	0	0	1
Robinia pseudoacacia	Black locust	0	0	1	1
	Total:	13	12	56	**81**