Summary of Bat Research in Cloquet Forestry Center, MN 2016

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Summary

Crews from the United States Forest Service and University of Minnesota – Natural Research Institute captured 28 bats at Cloquet Forestry Center from June 6th – 10th, 2016. Bats of three species were captured during mist-netting surveys. We captured 10 individuals of our target species, the northern long-eared bat, and attached transmitters to 4 adult females. These four were tracked to 7 unique roost trees of 2 species and 1 Cloquet Forestry Center building. During emergence counts we counted from 1 to 23 bats emerging from the roost trees. We observed 64 bats emerging during an emergence count at the building. Roost trees varied in diameter and height, as well as decay stage. The roosting patterns observed at Cloquet Forestry Center were similar to roosting patterns we have observed in other areas of Minnesota, where bats appear to be using a variety of available trees. This report details work done in Cloquet Forestry Center as part of a statewide study of northern long-eared bats. A report summarizing results of the statewide project will be available in early 2017.

Introduction

Bats are a critical component of Minnesota's ecosystems. A single bat may eat 1000 insects per hour, and the state's bats likely provide many millions of dollars in pest control each year (Boyles et al. 2011). Seven species of bats are known residents of 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), and hoary bats (*Lasiurus cinereus*, LACI).

There are four Minnesota bat species (northern long-eared bat, tricolored bat, little brown bat, and big brown bat) that hibernate in caves during the winter, and then disperse widely across the state in spring, summer, and fall. Very little is known about the summer habitat use of these species. These four cave-hibernating bats are all Species of Special Concern in Minnesota.

The U.S. Fish and Wildlife Service listed the northern long-eared bat as Threatened under the federal Endangered Species Act in April 2015, largely due to the impact of white-nose syndrome on bat populations (U.S. Fish and Wildlife Service 2016). White-Nose Syndrome (WNS) is caused by the fungus *Pseudogymnoascus destructans* which leads to increased winter activity and extremely high mortality rates of cave-hibernating bats (Frick et al. 2010). WNS has been moving through bat populations in the eastern states and provinces, with range expansions of WNS occurring every year (Turner et al. 2011). *P. destructans* was detected in Minnesota in 2013, and bat mortalities from WNS were first recorded during January 2016 at Lake Vermilion - Soudan Underground Mine State Park, near Soudan, MN (Minnesota Department of Natural Resources 2013, 2016a).

Maintaining reproductive success will be critical to the viability of Minnesota's bat populations as WNS spreads in Minnesota. Obtaining knowledge about maternity roosts before a population decline occurs will be critical for future efforts to reduce negative impacts of forest management and provide high quality habitat to support recovery of bat populations. Even if mortality rates can be reduced, there is still likely to be a drastic reduction in bat populations. Implementing management strategies that minimize mortality will be important as WNS continues to affect Minnesota bats.

In 2015, the Minnesota legislature approved $1.25 million in Environment and Natural Resources Trust Fund (ENRTF) funding for the project *Endangered Bats, White-Nose Syndrome, and Forest Habitat*, the goal of which is to collect data on the distribution and habitat use of the northern long-eared bat in Minnesota. This project is being conducted by the Minnesota Department of Natural Resources (MNDNR), the University of Minnesota Duluth – Natural Resources Research Institute (NRRI), and the USDA-Forest Service (USFS). Data for this project are being collected from across the state during 2015-2017. Data from year 1 of this project were summarized in a report released in the fall of 2015 (Swingen et al. 2015). Cloquet Forestry Center (CFC) served as one of 15 study sites for this project during 2016, with personnel from the USFS and NRRI mist-netting bats and personnel from NRRI conducting radio-telemetry and roost tree characterization.

Methods

Bat Capture/Processing

Fine mesh mist-nets (Avinet ., Dryden, NY, USA) were set up along forested roads that could act as travel corridors for bats. Each night, 2–4 mist-nets were set up within 200 m from a central processing location. Mist-nets were opened after sunset, and checked every 15 minutes for 2–5 hours, depending on capture rates and weather conditions. Captured bats were placed in cloth bags until processing.

Figure 1. Photos showing the techniques for capturing and processing bats. Photo Credits: A – Superior National Forest; B, D – Brian Houck, NRRI; C – Peter Kienzler, NRRI.

Figure 2. Photos showing techniques for processing bats and attaching bands and transmitters. Photo Credits: A – Christi Spak, MN DNR; B – Ryan Pennesi, USFS; C – Sarah Baker, NRRI; D – Morgan Swingen, NRRI.

We identified each captured bat to species by morphology, and determined sex, age, and reproductive condition by physical examination. Each captured bat was weighed and measured, and the wings were inspected for damage as per Reichard and Kunz (2009, Fig. 1, Fig.2). Biological samples (swabs) were taken from some bats for genetic testing, and were sent to the USDA – Forest Service Northern Research Station lab in Rhinelander, WI. Each bat was then fitted with an individually-numbered lipped aluminum wing band (Porzana Ltd., Icklesham, United Kingdom).

Radio-transmitters (A2414 Advanced Telemetry Systems Inc., Isanti, MN, USA; or LB-2X, Holohil Systems Ltd., Carp, ON, Canada) were attached to most reproductive adult female MYSE. We trimmed a small section of hair in the center of the back, and attached the transmitter to the skin using surgical adhesive (Perma-Type, Permatype Company Inc., Plainville, CT, USA, Fig. 2). Bats were released at the capture site after processing.

Tracking/Roost Tree Characterization

Bats with radio-transmitters were tracked to their roosts each day, until the transmitter failed, or the transmitter 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 emergence survey we recorded the number of bats emerging in each 10-minute interval, the location of the exit point, and whether or not the bat with the transmitter left the tree.

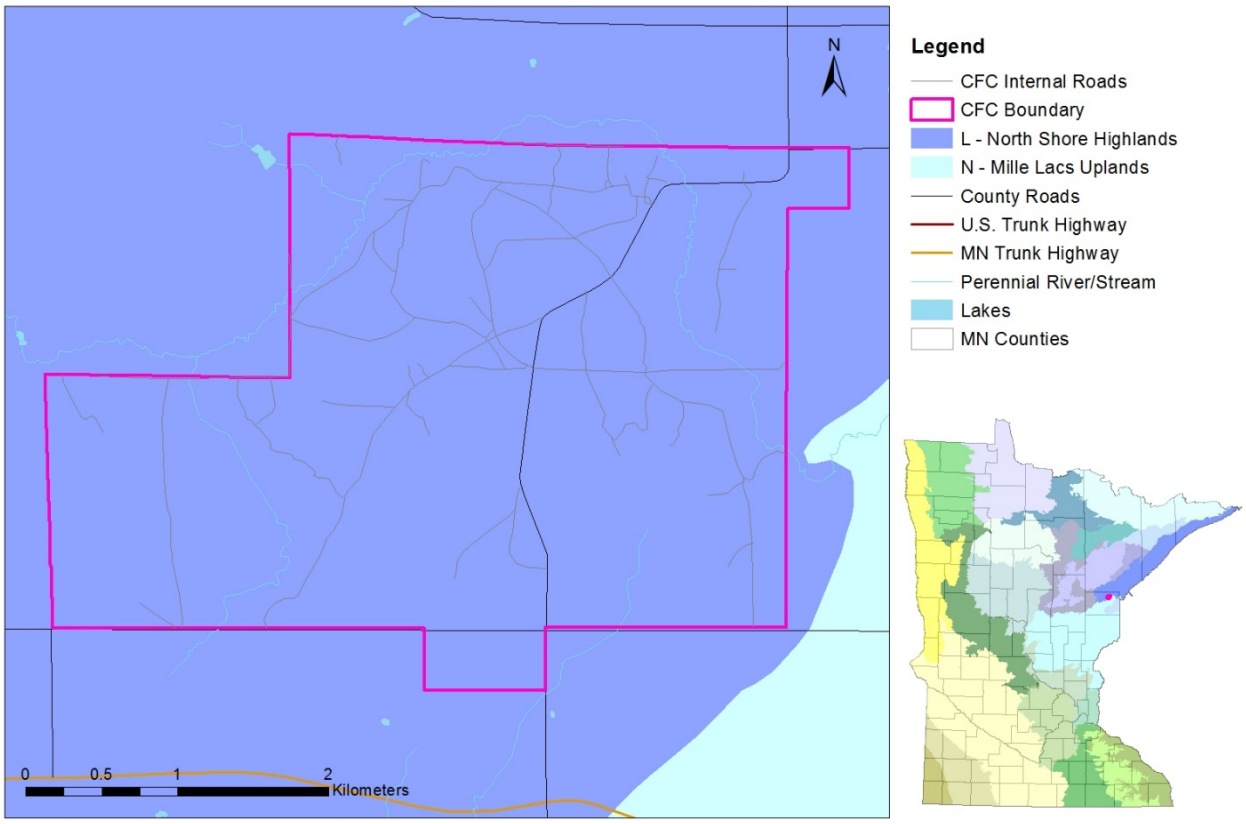
Crews returned to each roost tree to conduct a more detailed tree characterization after bats left. This included measuring roost diameter at breast height (DBH), tree height, decay stage, canopy closure, slope, aspect, and recording details about the vegetation surrounding the roost tree. All trees were marked with a numbered aluminum tree tag with the text “NLEB” (for Northern Long-Eared Bat) stamped on the tag (Fig. 3).

Figure 3. Photo of the type of aluminum tree tags used to permanently mark northern long-eared bat roost trees in Cloquet Forestry Center, June 2016.

Study Area

Bats were captured for the large-scale study at 15 locations around the state of Minnesota in 2016, including Cloquet Forestry Center (CFC). CFC is a research forest managed by the University of Minnesota, and was established in 1909. The forests at CFC are heavily managed and contain mainly pine, birch, and aspen in addition to some lowland forests (Fig. 4).

Figure 4. Map showing the Ecological Subsections overlapped by Cloquet Forestry Center in Carlton County, Minnesota.



Results

Mist-Netting

We mist-netted bats at three sites in Cloquet Forestry Center on the nights of June 6th, 8th, and 9th, 2016 (Fig. 5). We captured and processed 28 bats over a total of 21.25 net-hours. We captured three species, including the northern long-eared bat (Table 1). All bats captured were adults. Six of the nine female bats captured were pregnant while the rest appeared non-reproductive. Eleven of the 28 bats showed some wing damage consistent with that caused by WNS, and two of those eleven showed moderate wing damage.

Figure 5. Map of bat mist-netting sites at Cloquet Forestry Center, June 6th – 10th, 2016. The pie chart at each net site indicates the proportion of species captured at that site, and the size of the pie chart represents the total number of bats captured at that site relative to other sites.

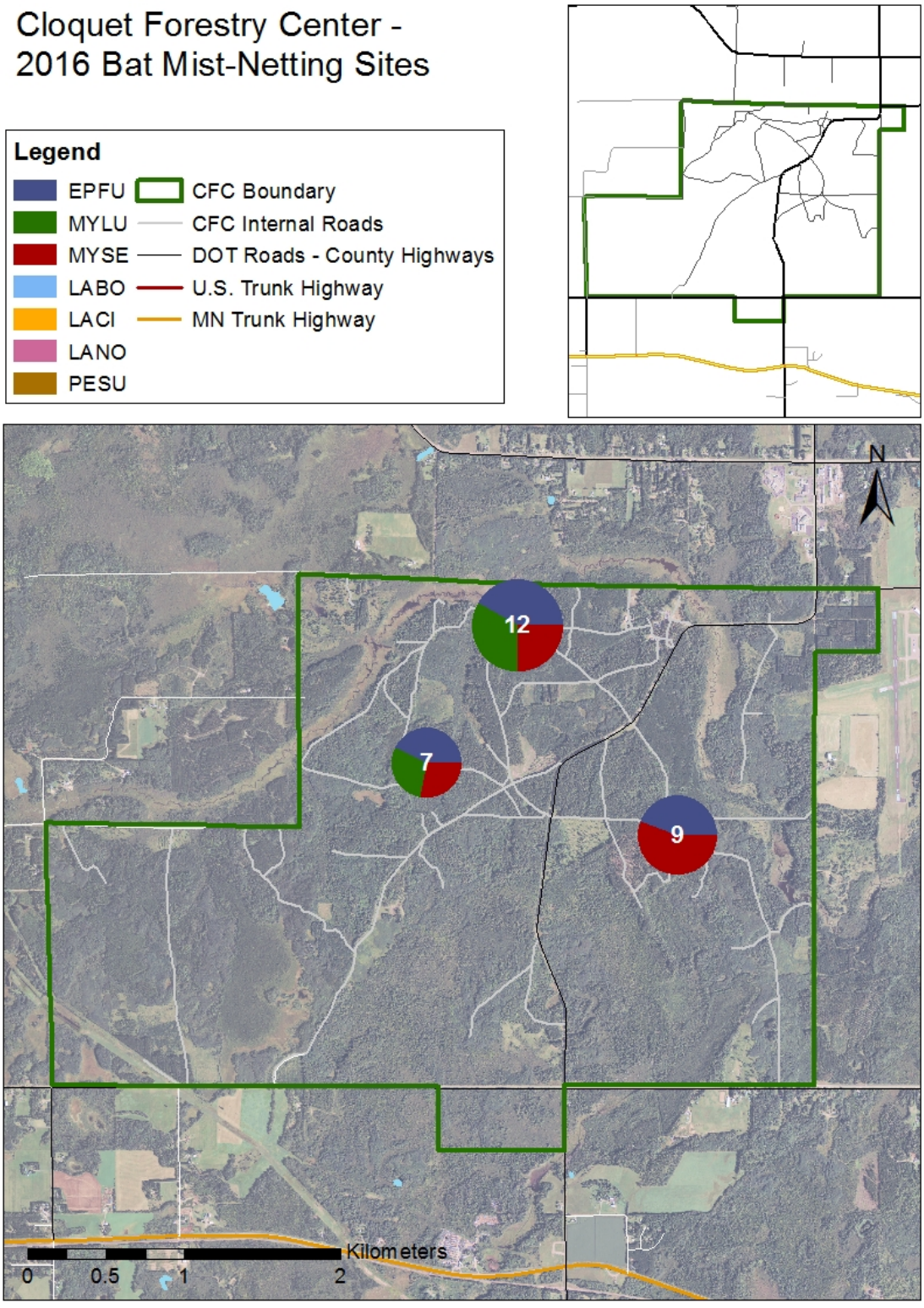


Table 1. Count of bats captured and processed at Cloquet Forestry Center, June 6th – 10th, 2016 by species and sex.

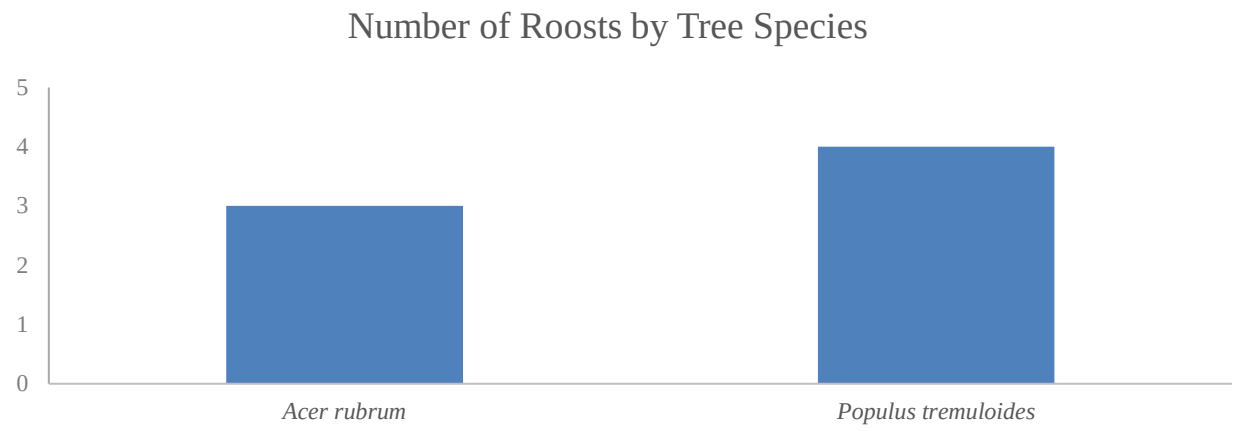
	Species Code							
Sex	**EPFU**	**LABO**	**LACI**	**LANO**	**MYLU**	**MYSE**	**PESU**	**Grand Total**
Female	0	0	0	0	2	7	0	**9**
Male	12	0	0	0	4	3	0	**19**
Grand Total	**12**	**0**	**0**	**0**	**6**	**10**	**0**	**28**

We attached radio-transmitters to four of the seven female MYSE captured; all four were pregnant at the time of capture. One transmitter was placed on a bat on the north side of the forest on the night of June 6th, and three on the east side of the forest on the night of June 8th, 2016.

Radio-Telemetry/Tree Characterization

The four bats with radio-transmitters were tracked until the transmitters failed or fell off, which was between 3–9 days. We tracked the four bats with radio-transmitters to seven unique roost trees of two species (Fig. 6, Fig. 7), and one building. A complete list of roost trees is in Appendix A. A detailed map of movement between roosts by bats with radio-transmitters is in Appendix B.

Figure 6. Histogram showing the number of northern long-eared bat roosts by tree species at Cloquet Forestry Center, June 2016. Seven total roost trees were identified.



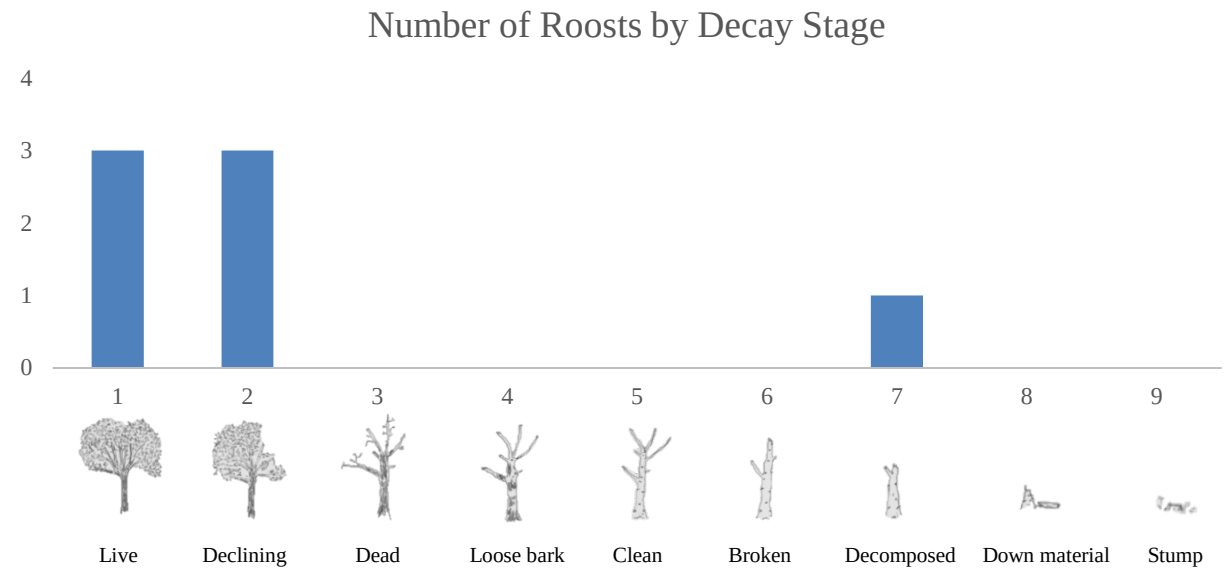
The average distance from the capture location to the first roost was 1089 m (range: 365 – 1437), and the average distance moved between consecutive roosts was 502 m (range: 33 - 1424). An average of 2.3 roosts were identified per bat, and these four bats spent an average of 1.5 days (range: 1-2) in each roost (of those roosting events with known start and end dates).

The roost trees varied in size from 24.2–60.8 cm in diameter at breast height (DBH), with an average DBH of 37.3 cm. Roosts were located in both live trees and dead trees of varying decay stage (Fig. 8). Roost tree height ranged from 2.9–23.3 m with an average of 13.4 m.

Figure 7. Photos of three different roosts at Cloquet Forestry Center. From left to right: a building at CFC headquarters, a trembling aspen snag (*Populus tremuloides*), and a live red maple (*Acer rubrum*).

Field crews were able to conduct 11 emergence counts on the 7 identified roost trees. Bats were observed exiting the roost tree in 7 of the emergence counts. Colony size (number of bats observed in one emergence count) ranged from 1–23 in those seven emergence counts, and averaged 13.6. One emergence count was conducted on the building, and 64 bats were observed exiting from under the eaves on the west side of the building.

Figure 8. Histogram showing variation in decay stage among seven northern long-eared bat roost trees identified at CFC, June 2016.



Discussion

The four bats with transmitters at Cloquet Forestry Center used a variety of roost trees, and moved often, which is consistent with findings both at other sites in this project and in other areas of the NLEB range. Under the 4(d) rule of the Endangered Species Act, there are restrictions on tree harvest within 150 ft of known, occupied roost trees from June 1st – July 31st. For more details on these restrictions, please visit the website of the U.S. Fish and Wildlife Service (https://www.fws.gov/Midwest/endangered/mammals/nleb/index.html). One of the northern long-eared bats with a transmitter at CFC also used a building as a roost, which is fairly unusual for NLEB. 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.

Crews captured or observed 3 of the 7 species of bats resident in Minnesota at Cloquet Forestry Center. None of the migratory tree bats (Eastern red bats, silver-haired bats, and hoary bats) were captured at CFC, although those species were all captured in northeastern Minnesota during this field season. An eastern red bat was also captured on nearby Carlton County land on June 7th, 2016. Tri-colored bats (*Perimyotis subflavus*) were not captured at CFC, which was not unexpected given their relatively limited range in the state. Tri-colored bats have been observed hibernating in small numbers in southeastern Minnesota (Nordquist and Birney 1985), and at least two have been found hibernating in the northeastern part of the state (Knowles 1992). Summer captures of tri-colored bats are uncommon – out of the more than 1000 individual bats captured over the past four summers as part of this project and pilot studies, only one tri-colored bat was recorded.

Also during the summer of 2016, the first capture of an evening bat (*Nycticeius humeralis*) in Minnesota was recorded in Ramsey County (Minnesota Department of Natural Resources 2016b). It is yet unknown if that capture represented a lone individual or a range extension for that species, however Wisconsin also recently documented the first maternity colony of evening bats in that state (Wisconsin Department of Natural Resources 2016).

The capture of 11 bats with wing damage consistent with WNS suggests that these bats were either hibernating in one of the known hibernacula in the state where WNS or *P. destructans* have been confirmed, or that there may be additional infected hibernacula in the state. Of the 646 bats captured during summer 2016 across Minnesota as part of the overall project, 43% showed some wing damage consistent with WNS.

This is one of 13 site-level reports from the 2016 field season, and is intended for use by the manager(s) and staff at Cloquet Forestry Center. A report summarizing and discussing the results from all locations will be available in early 2017 (Swingen et al. 2016).

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Appendix A. Table of NLEB Roost Tree Specifications

Roost Tree ID (Tag #)	Common Name	Species	DBH (cm)	Height (m)	Status	Decay Class
202	Trembling Aspen	*Populus tremuloides*	34.6	19.1	Live	1
230	Trembling Aspen	*Populus tremuloides*	32.4	2.9	Dead	7
232	Red Maple	*Acer rubrum*	44.5	9.3	Live	2
233	Red Maple	*Acer rubrum*	26.4	10.8	Live	1
234	Trembling Aspen	*Populus tremuloides*	38.0	23.3	Live	2
235	Trembling Aspen	*Populus tremuloides*	60.8	16.3	Live	2
269	Red Maple	*Acer rubrum*	24.2	11.9	Live	1

Appendix B. Maps of Bat Movement

Map of the site at which bats were mist-netted June 6th and 8th, 2016 (yellow triangles). Roost trees are symbolized by colored circles. Multicolored circles indicate a roost tree used by multiple transmittered bats. The bat with transmitter 165.511 was captured on 6/6 on the north side of the forest, and the other three bats with transmitters were captured on 6/8 on the east side of the forest.