PILOT STUDY OF NORTHERN LONG EARED BAT ROOST AND HABITAT USE AT DEVIL'S TOWER NATIONAL MONUMENT

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INTRODUCTION

This report briefly summarizes activities conducted under a 2015 pilot project to investigate the efficacy of identifying roost structures and associated habitat features used by northern long-eared bat (*Myotis septentrionalis*; MYSE) on Devil's Tower National Monument (DETO). MYSE was listed as threatened under the U.S. Endangered Species Act in April 2015, primarily resulting from massive declines in eastern populations caused by mortalities from White Nose Syndrome (United States Fish and Wildlife Service 2015b). Evidence from the eastern U.S. suggests MYSE almost always roosts in trees during the summer (Lacki et al. 2009), and evidence suggests that forest management practices can be used to provide favorable roosting sites for similar dwelling bats (Perry et al. 2008). Our knowledge of MYSE roost selection within the Black Hills region comes from only nine individual bats (Cryan et al. 2001). This lack of knowledge challenges land managers attempting to identify important areas and management techniques that can influence the persistence of MYSE and other bat species in the region. Ultimately, enhanced understanding of distribution and habitat associations of MYSE will help the National Park Service (NPS) in planning current management actions leading to preservation of this and other bat species, management actions in the near future under Endangered Species Act protections, and management actions in the more distant future under possible influence of White Nose Syndrome (WNS).

METHODS

With assistance from DETO personnel, staff from WYNDD captured bats via mist nets deployed in single-high arrays over water sources and double-high arrays in flight corridors that were shown to be frequented by MYSE based on previous survey efforts (Griscom and Keinath 2011). Survey methods conformed to recommended guidelines (e.g., Kunz and Parsons 2009, Sikes et al. 2011) and followed recommendations in Wyoming's bat conservation plan (Hester and Grenier 2005) for documentation and followed WNS protocols presented in Wyoming's WNS strategic plan (Abel and Grenier 2011). MYSE were fitted with 0.25 gram Blackburn VHF radio transmitters (Philip Blackburn, 819 Logansport Street, Nacogdoches, TX 75951) that were less than 5% of bat body mass (Aldridge and Brigham 1988). Procedures for transmitter attachment generally followed those approved for Indiana Bat (United States Fish and Wildlife Service 2015a). To attach the transmitter, a small patch of hair between the scapula approximately the size of the transmitter (8 mm X 2.8 mm) was carefully trimmed to expose the skin using small sterilized scissors and cleaned using a disposable alcohol pad. A small amount of surgical adhesive (Perma-Type Surgical Cement; http://www.perma-type.com/accesil.html) was applied to the trimmed area and allowed set for 5 - 10 minutes, after which the flat side of the transmitter was placed on the adhesive with the antenna facing the posterior end of the bat. Once the adhesive was dry (5 – 10 minutes), the bat was immediately released at the capture location. Radio tagged bats were tracked to day roosts every day until the signal was lost or the transmitter fell off.

We recorded features of roosts including roost type (e.g., tree, rock crevice, etc.), roost location, height of bat within the roosting structure, diameter at breast height (DBH) for roost trees, total height of roost trees, and life stage of roost trees (Figure 1). When possible, roosts were monitored at sunset to count the number of bats emerging. To assess forest features promoting occupation by MYSE, we conducted tree density transects centered on roost trees and

compared that information to transects conducted at random locations throughout DETO. Transects were belts 2 meters wide and 40 meters long. All trees whose center fell within the belt were counted and the resulting tally was used to estimate tree density within the transect. Transect results were then summarized to estimate tree densities across the landscape. For each tree counted, we also recorded tree species, DBH, total height of the tree. In order to develop landscape habitat relationships for porcupine and MYSE occurrence at DETO, WYNDD is in the process of compiling a tree cover map of the monument digitized from publically available aerial imagery (Figure 2). This data will be finalized at the time of the final MYSE report and provided to DETO as a shapefile, but draft versions can be obtained earlier if requested.

RESULTS AND RECOMMENDATIONS

We conducted 6 mist net sessions over three visits to DETO, during which we captured 37 bats of 8 species, including the first Long-legged Myotis (*Myotis volans*) ever captured in the park (Table 1). Captured species included Big Brown Bat (*Eptesicus fuscus*), Silver-haired Bat (*Lasionycteris noctivagans*), Western Small-footed Myotis (*Myotis ciliolabrum*), Western Long-eared Myotis (*Myotis evotis*), Little Brown Myotis (*Myotis lucifugus*), Northern Long-eared Myotis (*Myotis septentrionalis*), Fringed Myotis (*Myotis thysanodes*), and Long-legged Myotis.

We placed radio tags on 8 NLEB, 7 of which were males and one of which was a non-reproductive female (Table 2). Bats were tracked an average of 5 days, although two bats were never located following transmitter attachment. Ten roost locations were documented (Table 3). Mean distance from capture locations to roosts was 410 meters (standard deviation 437 meters), and most roosts were located in snags occurring in forested drainages on the northwest side of the tower (Figure 3). Most roosts were moderate to large ponderosa pine snags, but several were in small burr oak snags and one was in a rock crevice (Table 3, Figure 4). To our knowledge, this is the first evidence of MYSE roosting in rock crevices. Bats seemed to show fidelity to roosting areas, roosting in the same one or two locations for the duration of the tracking period. MYSE often switched between roosts every few days, but this seemed to differ by individual, with some individuals staying in the same roost for the entire tracking period.

This pilot study proved the efficacy of radio tagging and roost location, and we recommend expansion of this effort in coming years. To make analyses meaningful, we would need to double or triple the sample size of the current pilot effort. This means tagging 15 – 30 bats from a wider array of areas across the monument, so that captures (and associated roost locations) are not biased toward one location. Also, captures would ideally occur throughout the summer, beginning in late May or early June and extending through August.

The biggest limiting factor preventing increased sample size is our ability to catch MYSE at DETO. Only one site on the monument (DT013 on Figure 3) provides reliable capture of MYSE and all bats captured there were males. All other MYSE sites that we identified are very low-productivity, often resulting in capture of no, or perhaps one, MYSE after a full night of mist netting. Extensive searching of the monument has not revealed any other sites with a high potential for capturing MYSE. This is primarily due to the lack of suitable bodies of water in forested portions of the monument. Without such waterbodies, we need to find suitable flight corridors within which multi-tier canopy nets can be deployed. Even under ideal conditions, nets in flight corridors have low capture rates, and the open structure of the forests at DETO means such sites are also limiting in the environment. Therefore, in order to increase sample size to 15

– 30 bats, we anticipate needing to at least quadruple the mist netting effort (i.e., roughly 24 nights of mist netting spread across the summer).

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TABLES AND FIGURES

Table 1: Bats captured during summer of 2015 as part of this pilot study. Shaded lines indicate Northern Long-eared Bats that were radio-tagged and subsequently tracked to day roosts. Location of capture sites are shown in Figure 2.

Capture	Site Name	Survey Date	Species *	Age **	Repro. Status ***	Forearm Length (mm)	Ear Length (mm)	Weight (g)	Bat ID
1	DT14	2015-07-08	MYEV	A	N	40.4	17.0	10.0	
2	DT14	2015-07-08	EPFU	A	P	46.0	12.0	22.0	
3	DT14	2015-07-08	MYSE	A	N	34.0	15.0	9.0	172.079
4	DT14	2015-07-08	EPFU	A	N	45.0	13.0	20.0	
5	DT14	2015-07-08	MYVO	A	P	39.0	10.0	10.0	
6	DT14	2015-07-08	EPFU	A	L	49.0	13.0	17.0	
7	DT13	2015-07-09	MYEV	A	N	37.7	17.1	9.0	
8	DT13	2015-07-09	MYTH	A	N	39.0	16.0	10.0	
9	DT13	2015-07-09	MYTH	A	N	39.0	16.0	10.0	
10	DT13	2015-07-09	MYTH	A	L	39.0	16.0	10.0	
11	DT13	2015-07-09	MYLU	A	N	37.0	11.0	9.0	
12	DT13	2015-07-09	MYEV	A	N	39.1	14.0	5.0	
13	DT13	2015-07-09	MYTH	A	L	37.0	18.0	9.0	
14	DT13	2015-07-09	MYTH	A	L	39.5	15.6	8.0	
15	DT13	2015-07-09	MYTH	A	L	39.7	16.1	9.0	
16	DT13	2015-07-09	MYSE	A	N	33.0	15.0	8.0	172.211
17	DT13	2015-07-09	MYTH	A	P	40.0	18.0	0.0	
18	DT13	2015-07-09	MYSE	A	N	34.0	15.0	8.5	172.903
19	DT13	2015-07-09	MYSE	A	N	32.6	14.6	7.0	
20	DT13	2015-07-09	MYSE	A	N	32.5	15.4	6.5	
21	DT13	2015-07-09	MYTH	A	L	38.9	14.9	10.0	
22	DT08a	2015-08-10	LANO	A	N	42.8	10.3	19.0	
23	DT08b	2015-08-10	MYSE	A	N	35.5	15.0	6.0	172.1188
24	DT13	2015-08-11	MYLU	J	N	40.0	1.0	9.0	
25	DT13	2015-08-11	MYCI	A	N	31.2	10.0	4.0	
26	DT13	2015-08-11	MYTH	J	N	38.5	15.0	6.0	
27	DT13	2015-08-11	MYLU	A	N	37.0	13.0	9.0	
28	DT13	2015-08-11	MYTH	A	N	37.8	19.0	7.0	
29	DT13	2015-08-11	MYSE	A	N	34.3	14.0	5.0	172.872
30	DT13	2015-08-11	MYSE	A	N	36.0	17.0	7.0	172.2114
31	DT13	2015-08-11	MYVO	A	L	39.4	10.0	9.0	
32	DT13	2015-08-11	MYTH	A	N	36.0	19.0	8.0	
33	DT13	2015-08-11	MYSE	A	N	33.9	16.0	7.0	172.3179
34	DT13	2015-08-12	MYSE	A	N	33.5	16.0	7.0	172.1353
35	DT13	2015-08-12	MYSE	A	N	38.2	16.5	8.0	
36	DT14	2015-08-27	MYVO	A	N	40.3	11.5	7.0	
37	DT14	2015-08-27	MYCI	A	N	32.5	11.0	5.0	

* Species codes are as follows: EPFU = Big Brown Bat (*Eptesicus fuscus*), LANO = Silver-haired Bat (*Lasionycteris noctivagans*), MYCI = Western Small-footed Myotis (*Myotis ciliolabrum*), MYEV = Western Long-eared Myotis (*Myotis evotis*), MYLU = Little Brown Myotis (*Myotis lucifugus*), MYSE = Northern Long-eared Bat (*Myotis septentrionalis*), MYTH = Fringed Myotis (*Myotis thysanodes*), MYVO = Long-legged Myotis (*Myotis volans*)

** Ages: A = Adult, J = Juvenile.

*** Reproductive Status: L = Lactating, N = Non-Reproductive, P = Pregnant.

Table 2: Sequential locations of radio-tagged bats located during the summer of 2015 as part of this pilot study. Repeated locations of individuals are shaded similarly. Associated locations of these bats and their roosting structures can be found in Figure 2.

Bat ID	Obs. Date	Bat Located	UTME (NAD83 Zone13)	UTMN (NAD83 Zone13)	Roost Type	Roost ID	Notes
172.079	2015-07-09	Y	0522307	4937843	Tree	R01	Small burr oak snag. Roosting in cavity
172.079	2015-07-10	Y	0522307	4937843	Tree	R01	Same tree and cavity as previous day. No visual on bat, but antenna visible
172.079	2015-07-11	Y	0522307	4937843	Tree	R01	Same tree and cavity . Confirmed bat in cavity. Yay!
172.079	2015-07-12	Y	0522307	4937843	Tree	R01	Same cavity and snag
172.079	2015-07-13	Y	0522307	4937843	Tree	R01	Transmitter most responsive where observed emergence
172.1188	2015-08-12	N					not located
172.1188	2015-08-13	N					not located
172.1188	2015-08-14	N					not located
172.1353	2015-08-12	N					not located
172.1353	2015-08-13	N					not located
172.1353	2015-08-14	N					not located
172.211	2015-07-10	Y	0521804	4937719	Tree	R03	Two snags together: one snag caught on branch of standing snag: bat in middle of 2.
172.211	2015-07-11	Y	0521801	4937710	Tree	R05	Believed bat is in cavity on broken branch
172.211	2015-07-12	Y	0521810	4937714	Tree	R06	Near R05 and R03. leaning standing snag
172.211	2015-07-13	N					Could not locate 172.2100
172.211	2015-07-17	N					Tried since 0830 to locate bats no, luck
172.211	2015-07-19	N					Tried to locate for 3hrs-no bats
172.2114	2015-08-12	N					not located
172.2114	2015-08-13	N					not located
172.2114	2015-08-14	Y	0523059	4938446	Tree	R10	Roosting in live tree with broken branch
172.2114	2015-08-15	Y	0523059	4938446	Tree	R10	Roosting at 12.2m east facing broken off branch , same tree as previous day
172.2114	2015-08-16	Y	0523059	4938446	Tree	R10	same roost area as yesterday
172.2114	2015-08-17	Y	0523059	4938446	Tree	R10	same tree and cavity
172.2114	2015-08-18	Y	0523059	4938446	Tree	R10	same tree
172.2114	2015-08-19	Y	0523059	4938446	Tree	R10	Found bat in same tree/cavity
172.2114	2015-08-20	Y	0523059	4938446	Tree	R10	Found in same tree
172.2114	2015-08-21	Y	0523059	4938446	Tree	R10	Same tree
172.3179	2015-08-12	Y	0521961	4937727	Rock Crevice	R08	searched for hours in location went away behind rock; GPS point 2114@266
172.3179	2015-08-13	Y	0521418	4937938	Tree	R09	Roosting in live tree with broken off top
172.3179	2015-08-14	Y	0521418	4937938	Tree	R09	Roosting in live tree with broken off top
172.3179	2015-08-15	Y	0521418	4937938	Tree	R09	same tree as previous day roost on SW side tree, broken branch with 2 holes in it and broken top from ground
172.3179	2015-08-16	Y	0521418	4937938	Tree	R09	same tree, hard to pin point roost today similar upper area

Bat ID	Obs. Date	Bat Located	UTME (NAD83 Zone13)	UTMN (NAD83 Zone13)	Roost Type	Roost ID	Notes
172.3179	2015-08-17	N					Bat not in roost and unable to find
172.3179	2015-08-19	Y					bat moved over w boundary probably 50-70 m; not located exactly though roost recorded as R11
172.3179	2015-08-20	N					Bat tracked to outside the park. See attached map
172.3179	2015-08-21	N					Tracked to outside the park. See attached map
172.872	2015-08-14	Y	0522200	4937787	Tree	R07	Roosting in bend of tree
172.872	2015-08-12	Y	0522200	4937787	Tree	R07	fire charred tree, roosting in bend of tree
172.872	2015-08-13	Y	0522200	4937787	Tree	R07	Roosting in bend of tree
172.872	2015-08-15	Y	0522200	4937787	Tree	R07	Same tree cavity: confirmed transmitter
172.903	2015-07-10	Y	0521982	4937776	Tree	R02	Downed ponderosa over hanging on cliff visual confirmation of bat
172.903	2015-07-11	Y	0521956	4937766	Tree	R04	Saw bat under exfoliating bark snag
172.903	2015-07-12	Y	0521956	4937766	Tree	R04	Same cavity and snag physical confirm
172.903	2015-07-13	Y	0521956	4937766	Tree	R04	Saw bat with transmitter same spot
172.903	2015-07-14	Y	0521956	4937766	Tree	R04	Saw bat, some snag, but moved upon sighting
172.903	2015-07-15	N					Couldn't locate was not in R04 or R02 weak signal to south but never found 2hrs
172.903	2015-07-17	N					Tried since 0830 to locate bats no, luck
172.903	2015-07-19	N					Tried to locate for 3hrs-no bats

Table 3: Roost structures identified by tracking radio-tagged bats. Location of roosts can be found in Figure 2.

Roost ID	Bat ID	Roost Type	Tree Status	DBH (in)	Structure Height (m)	Bat Roost Height (m)	Loose Bark	Cavity Presence	Emergence Count	UTME (NAD83 Zone13)	UTMN (NAD83 Zone13)	Description
R01	172.079	Burr Oak	4	5.0	1.5	1.5	Much	Yes	1	0522307	4937843	Bat roosting in cavity at top of snag. Visual observation of animal.
R02	172.903	Ponderosa Pine	10	18.0	0.5	0.5	Much	No	na	0521982	4937776	Downed tree; roost under sloughing bark. Visual observation of animal.
R03	172.211	Ponderosa Pine	4	17.8	18.6	17.8	Much	Yes	na	0521804	4937719	
R04	172.903	Burr Oak	4	5.9	7.7	1	Much	Yes	1	0521956	4937766	Roost about 2 feet up in tree.
R05	172.211	Ponderosa Pine	1	28.0	23.4	16.7	Some	Yes	na	0521801	4937710	
R06	172.211	Ponderosa Pine	2	23.0	17.9	0.5	Much	Yes	na	0521810	4937714	Tree spilt open at base; roost near ground level.
R07	172.872	Ponderosa Pine	4	14.0	2	2	Much	Yes	na	0522200	4937787	Bat roosting where branch broken..
R08	172.3179	Rock Crevice	na	na	6.5	1.5	na	na	na	0521961	4937727	Large sandstone cliff, south facing crack.
R09	172.3179	Ponderosa Pine	1	19.4	14.1	6.4	None	No	na	0521418	4937938	Top of tree broken, still alive.
R10	172.2114	Ponderosa Pine	1	11.1	18.2	d	None	No	na	0523059	4938446	Split, broken off branch near top. Stand of trees in valley, 30m from clearing.

Figure 1: Tree senescence stages used to classify roost trees of northern long-eared bat on Devil's Tower National Monument. Adapted from (Maser et al. 1979) .

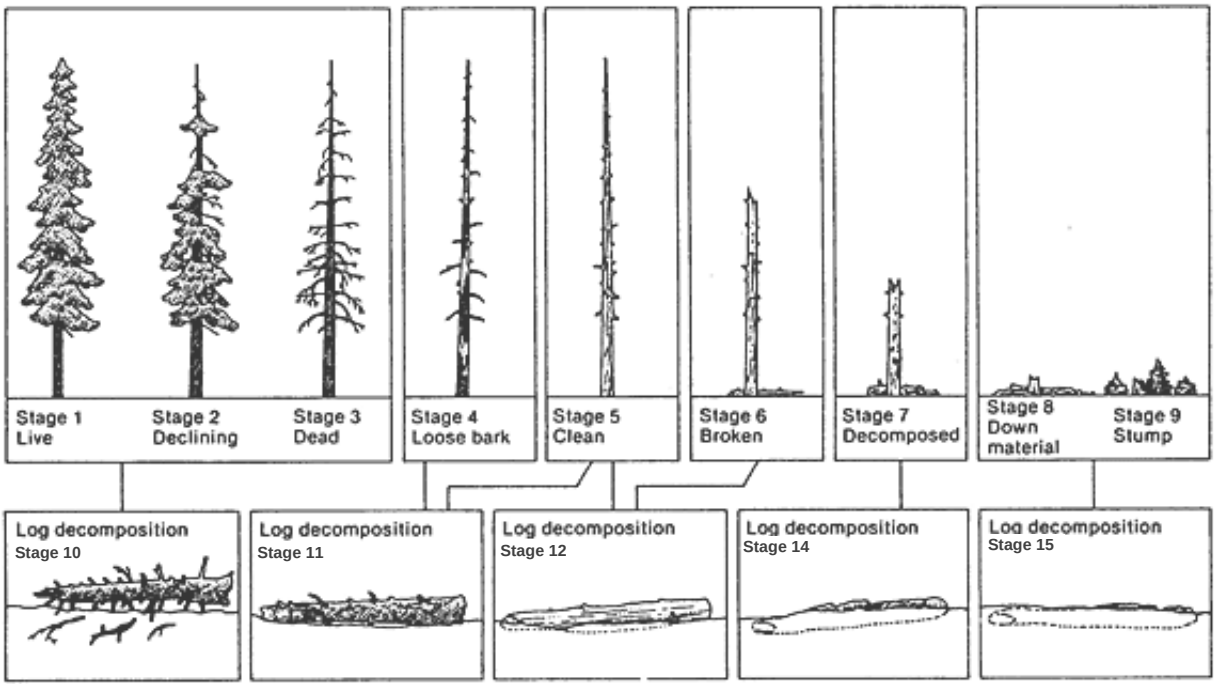

Figure 2: Percent tree cover in 25 meter pixels for all of Devil's Tower National Monument, digitized using digital imagery from ESRI.

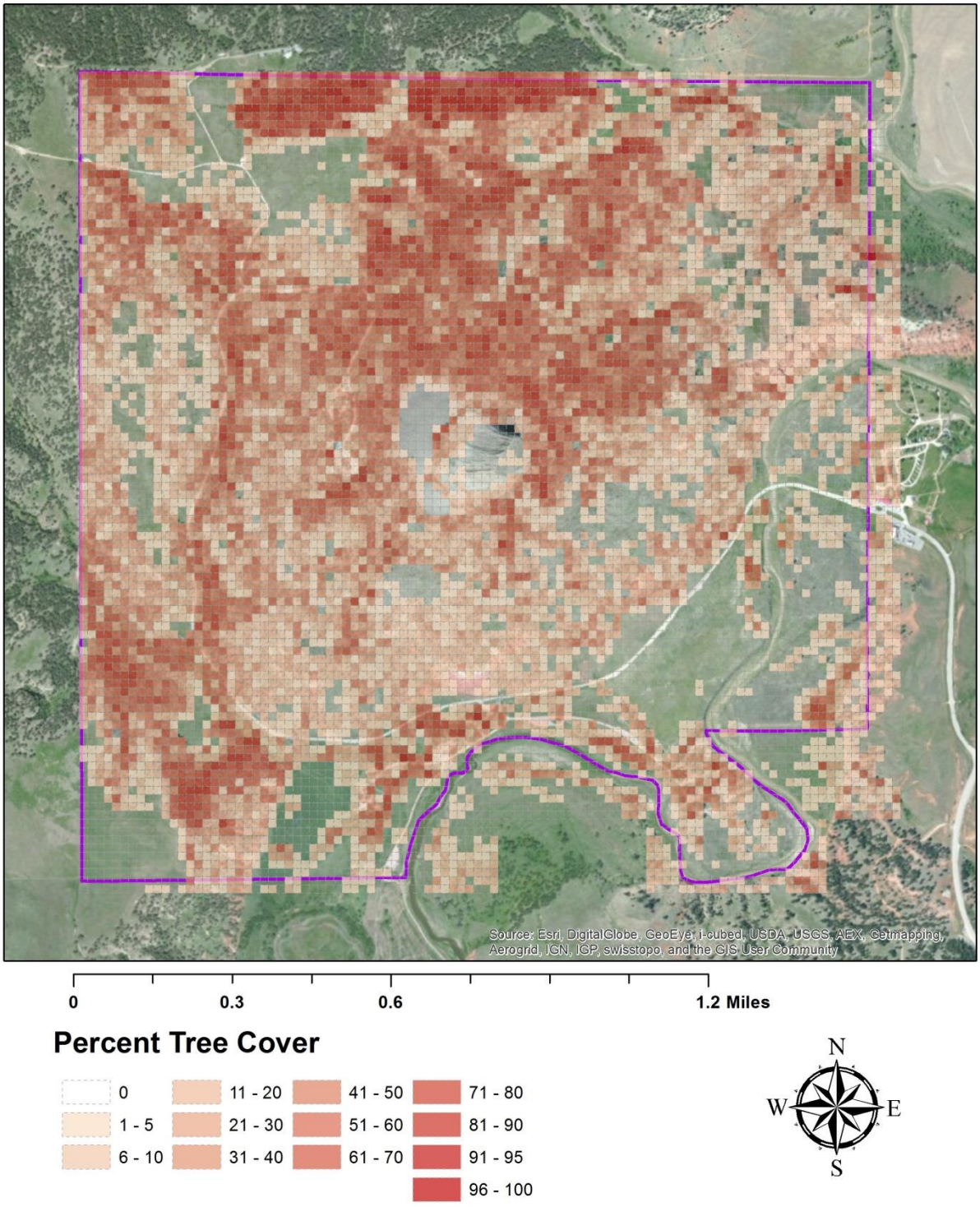

Figure 2: Map of sites in Devil's Tower National Monument showing mist net sites where we attempted to capture and radio-tag Northern-longed Eared Bat (yellow squares), and locations to which radio-tagged bats were subsequently found roosting (pink circles). Circle numbers (R01, R02, etc.) indicate specific roosts whose information is presented in Table 3.

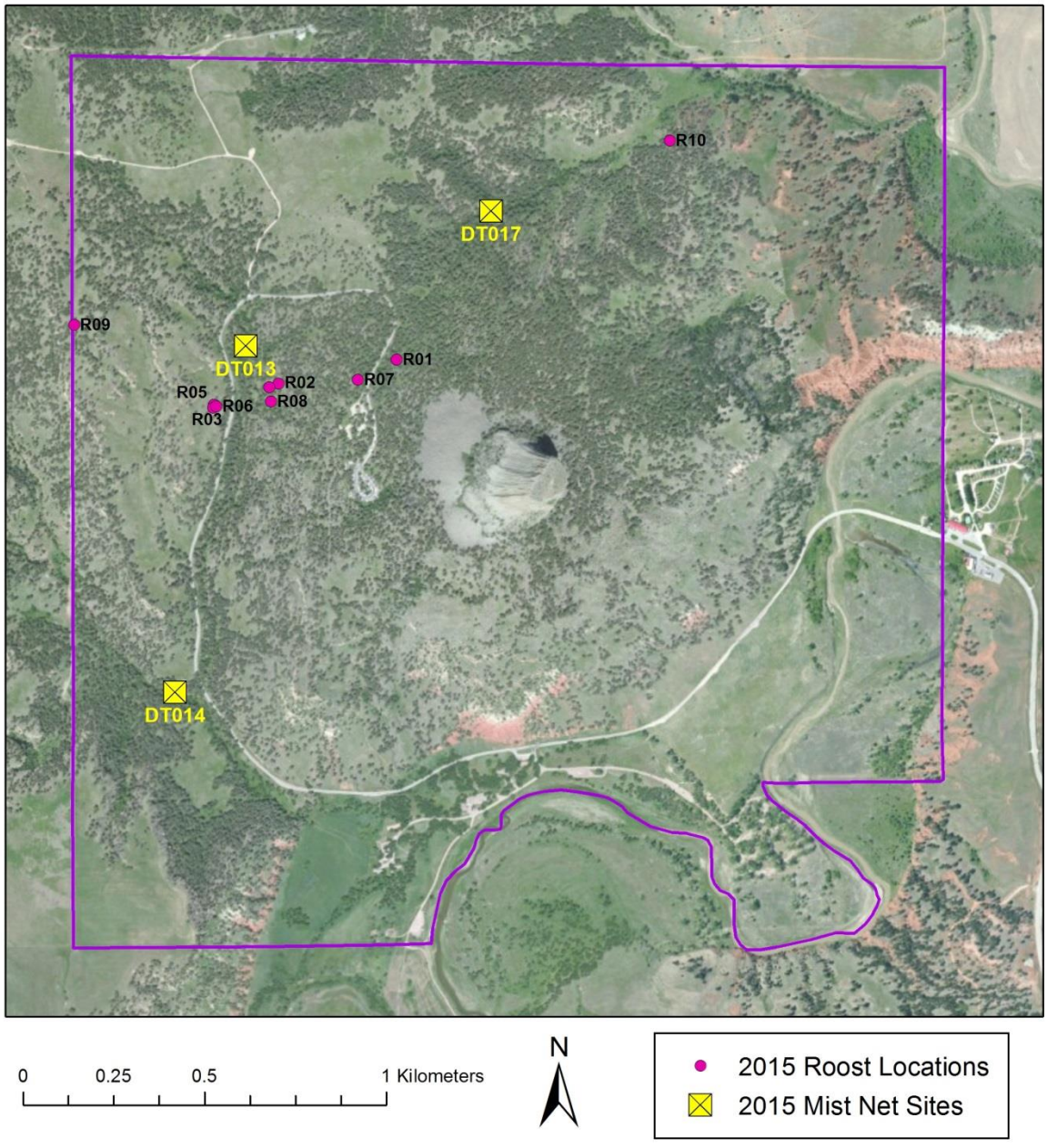

Figure 3: Examples of Northern Long-eared Bat roost structures on Devil's Tower National Monument. Roost numbers (R01, R02, etc.) are the same as those presenting in Tables 2 and 3 and Figure 2. Red arrows indicate approximate location of roosting bat.