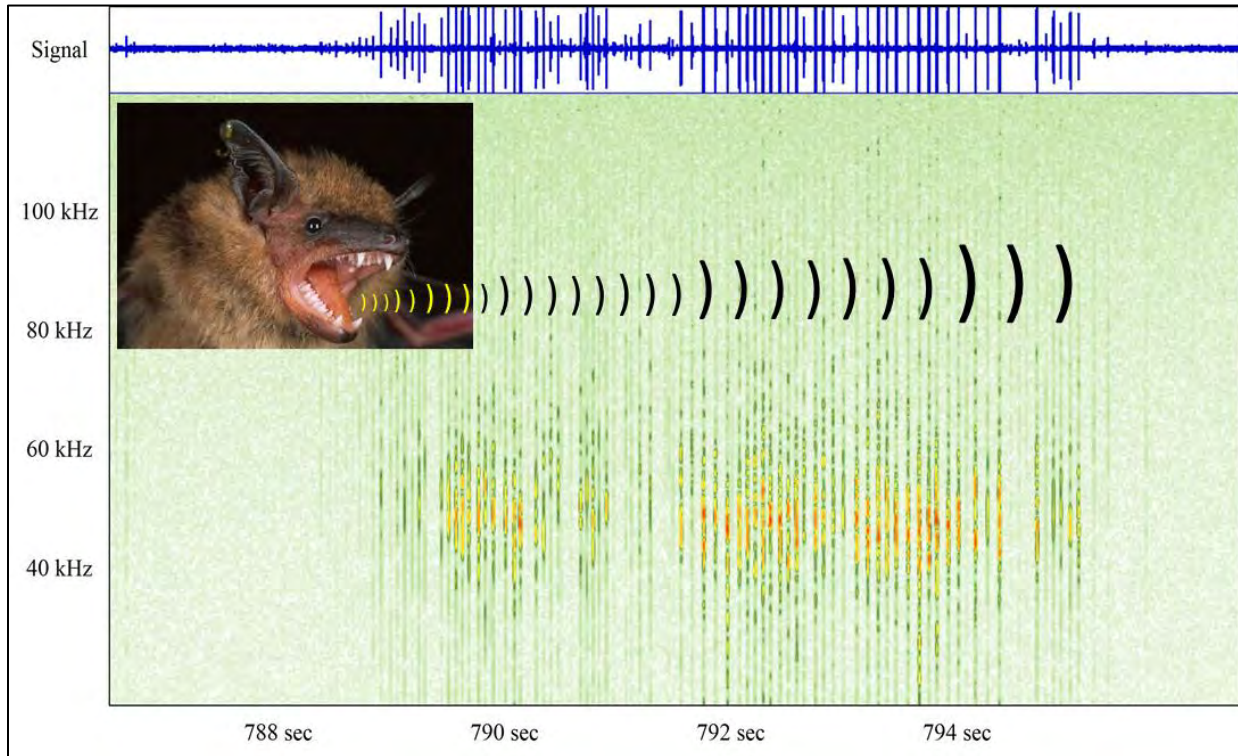


**Acoustic Survey of Bats at the Proposed EMDF Site 7a/7c**

**Bear Creek Valley**

**Oak Ridge Reservation**



**Tennessee Department of Environment and Conservation**

**Division of Remediation**

**Oak Ridge Office**

**February 2017**

## **Executive Summary**

During the late summer of 2016, the Tennessee Department of Environment and Conservation, Division of Remediation Oak Ridge Office (TDEC) completed an acoustic survey of bat species on the proposed Environmental Management Disposal Facility (EMDF) site 7a/7c in Bear Creek Valley on the Oak Ridge Reservation (ORR). The investigation was designed to identify all bat species present at the site and to determine locations where federally listed threatened and endangered (T&E) species (Indiana bat, Gray bat, Northern Long-eared bat) may be present. Twenty-six locations were monitored with bat detectors both onsite and around the proposed EMDF site for multiple, consecutive nights recording bat call data. Bat detectors were pre-programmed to monitor and record bat echolocation calls from dusk until dawn each survey night. Approximately 185,849 files of field acoustic data (i.e., bat calls) were recorded at 26 field stations and were processed with specialized, automated bat identification software yielding 16,202 bat call identifications. Fourteen bat species were indicated at the site based upon the results of acoustic software identification of bat calls. This survey was conducted during August 25 through September 27, 2016, outside the recommended U.S. Fish and Wildlife Service (USFWS) time schedule for Indiana bat surveys (i.e., May 15 through August 15). TDEC recommends the Department of Energy (DOE) conduct additional acoustic surveys and a habitat assessment (between May and August) prior to tree removal at the proposed EMDF site.

## Introduction

TDEC conducted this acoustic study to collect pre-construction bat survey data at the proposed EMDF site 7a/7c. Although acoustic bat surveys have been undertaken at a nearby storm-damaged site in Bear Creek Valley, this specific site has not been previously surveyed for bats. Historically, bat surveys on the ORR have been sporadic with only a handful of acoustic and mist-net surveys being conducted in recent years and little is known about bat distribution and species diversity. The objectives of this study include: (a) identify potential bat habitat at the site, (b) deploy acoustic detectors to record bat echolocation calls for analysis, (c) provide an inventory of onsite bat species with a special focus on T&E species, and (d) determine foraging activity and occupancy density estimates of bat species in a post-White Nose Syndrome (WNS) landscape as a means of monitoring population declines on the ORR.

White Nose Syndrome disease is believed to have been accidentally introduced from Europe into a New York cave thus infecting bats present there in 2006 (Cryan et al. 2013, Zukal et al. 2016). Since that time, WNS has spread exacting a heavy toll on cave bat populations with approximately six million bat mortalities in North America (Knudsen et al. 2013, Alves et al. 2014, Coleman et al. 2014). The culprit is an introduced fungus (*Pseudogymnoascus destructans*) that thrives at temperature and humidity ranges found in caves and abandoned mines (Verant et al. 2014, Hayman et al. 2016). The WNS fungus manifests itself on cave bats during hibernation as a white, fuzzy growth infecting the epidermis on their muzzles, ears and wings, giving them a frosted appearance. Bats that become infected with WNS face myriad physical ailments. The disease affects the arousal periods of hibernating bats, causing them to use their fat reserves prior to spring emergence, essentially causing emaciation and starvation of the bats (TBWG 2016). The WNS fungus infects and erodes bat tissues such as the bat wing creating scarring and holes in the tissue, skin lesions, and further physiological symptoms include electrolyte depletion and dehydration (Cryan et al. 2013).

In just 10 years since the first WNS-infected bats were discovered in New York, the WNS fungus has spread and infected cave bats in 29 states and 5 Canadian provinces. The disease has severely affected seven cave bat species including federally listed T&E species (Indiana bat, Gray bat, Northern Long-eared bat). In Tennessee, WNS-positive bats have been confirmed in approximately fifty counties (TBWG 2016). It should be noted there are >55 known caves plus numerous karst features on or near the ORR that may support several species of bats including T&E species. Because of WNS, bats are high profile mammals since their eventual destiny at this time is unknown especially for the bats being hit the hardest by the disease (i.e., extinctions or recovery?). It is imperative to minimize adverse impacts to the bats and bat habitat where new construction projects may disturb aquatic resources and involve extensive timber removal, which could be detrimental to these species and their habitat, limiting their potential conservation and recovery. Cave bat surveys in Anderson and Roane counties have documented WNS-positive bats (TBWG 2016) making ORR bats extremely vulnerable to human disturbances.

Depending on the species, bats often rely on forests for daytime and nighttime roosting, either in foliage, in tree cavities, or under loose bark of live trees and snags (i.e., standing dead trees). For

example, Indiana bats prefer caves for winter hibernation and during the warm spring-summer months, females form maternity roosts in tree holes or underneath tree bark to raise their pups (i.e., young bats). The USFWS has published a framework suggesting timber removal at a project site should only occur during the fall/winter season (bat hibernation period). In other words, trees should not be harvested during spring/summer season when bats are using trees (and forests) for foraging, roosting, and while females are raising their young (USFWS 2016a, 2016b, 2016c).

Specific structural components, such as snags, are required by many forest roosting bats and bats select roosts in part based on local and surrounding landscape features, especially those supporting large invertebrate prey items (flying insects) for foraging and feeding (Kunz and Lumsden 2003). Both landscape and local stand characteristics are important in roost selection (Miles et al. 2006, Perry et al. 2008), and availability of and proximity to water is an important criteria for many species (Silvis et al. 2016). Stream corridors not only provide critical drinking areas, they also provide excellent foraging habitat for most bats, and aquatic resource areas frequently have greater levels of bat activity than surrounding areas (Carter 2006, Ford et al. 2006, Johnson et al. 2010, Menzel et al. 2005, Ober and Hayes 2008).

Members of the *Myotis* genus are mainly cave bats and include the three T&E bat species found on the ORR. Cave bats are under heavy pressure from the WNS disease. Species of special interest for this study include the Indiana bat (*Myotis sodalis* or "MYSO"; federally listed endangered), the Northern Long-eared bat (*Myotis septentrionalis* or "MYSE"; federally listed threatened), and the Gray bat (*Myotis grisescens* or "MYGR"; federally listed endangered).

The MYSO and MYSE bats are primarily considered forest-dwelling bats because most recorded summer roosts are in trees  $\geq 3$  inches diameter at breast height (DBH) (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Perry et al. 2008, Johnson et al. 2012). During summer (May–August), MYSO and MYSE bat females form maternity colonies within cavities or crevices or under exfoliating bark of live or declining trees and snags (Lacki and Schwierjohann 2001, Carter and Feldhamer 2005, Silvis et al. 2016). Roosting colonies larger than 100 have been reported (Kurta 2005, Kniowski 2011), but average colony size is probably between 50 and 90 (Callahan et al. 1997, Harvey 2002, Kurta and Murray 2002, Adams et al. 2015). Males usually roost solitarily in trees during summer months (Kurta and Murray 2002, Britzke et al. 2003, 2006, Timpone et al. 2010).

The MYSO (Indiana) bats may forage in forests with intact canopies, near headwater streams (Menzel et al. 2005, Schirmacher et al. 2007), and within riparian zones (Webb 2000, Ford et al. 2005). The MYSO bats hibernate in caves or, occasionally, in abandoned mines during winter (Menzel et al. 2001, Britzke et al. 2002, Timpone et al. 2010). For hibernation, bats require cool, humid environments (caves) with stable temperatures, but above freezing. Cave temperatures generally approximate mean annual surface temperatures, which in mid-latitudes of North America range between 50°Fahrenheit (F) and 60°F (i.e., 10° to 15.5°C; Tuttle 1991). Following hibernation, MYSO bats migrate to their summer habitat in forested areas where they usually roost under loose or exfoliating tree bark on live, dead, or dying trees that are exposed to solar radiation (Kurta and

Murray 2002, Loeb and Winters 2013, Jachowski et al. 2016). At least 33 tree species have been found as roosts for reproductive female MYSO bats, and 87 percent of them are ash (13%), elm (13%), hickory (22%), maple (15%), poplar (9%), and oak (15%; USFWS 2007). During summer, males roost alone or in small groups, while females roost in larger groups. Maternity roosts may contain 100 to 350 individual bats during July and August (Kiser et al. 1998). MYSO bats also forage in or along the edges of forested areas and are known to migrate up to 360 miles (579 km) from their hibernacula to find suitable summer habitat to raise offspring (Kurta and Murray 2002, Winhold and Kurta 2006).

The MYSE (Northern Long-eared) bats are a forest interior species that require adequate canopy closure for foraging habitat (Lausen 2009) and relatively open canopy around maternity roosts (Garroway and Broders 2008). Suitable MYSE roosts are trees (live, dying, dead, or snag) with a DBH of  $\geq 3$  inches (7.5 cm; USFWS 2014). During the summer, the MYSE bats will roost singly or in colonies high in trees underneath loose exfoliating or flaking bark, in cracks, cavities or in crevices of both live trees and snags or dead trees (Carter and Feldhamer 2005, Lacki and Schwierjohann 2001, Lacki et al. 2009, Park 2010). The MYSE bats choose day roosts in tall trees and snags whereas night roosts for this species include caves and rock shelters where they will rest between feeding bouts (Caceres and Barclay 2000). Although they are mainly a forest interior species, MYSE bats will use riparian areas for foraging and seem to prefer streams and wetlands protected by canopy closure (Yates and Muzika 2006, Henderson and Broders 2008). These bats spend winter hibernating in caves and mines (i.e., known as hibernacula; Latin="tent for winter quarters"). The MYSE bats hibernate deep in crevices in caves, rather than clustering on exposed surfaces like other cave bats (Caceres and Barclay 2000). Overall, MYSE is not considered to be a long-distance migrant but typically wanders 40 to 50 miles (64 to 80.5 km) although known migratory distances vary greatly between 5 and 168 miles (8 to 270 km; USFWS 2014).

The MYGR (Gray) bats are year-round cave residents, occupying cold and deep hibernating caves (hibernacula) in winter and warm caves in summer that may be situated on or near a river (Tuttle 1976, Gore 1992). They may migrate as far as 310 miles (500 km) from summer caves to reach hibernation caves (Mitchell and Martin 2002). Forested areas surrounding caves or located between caves and foraging habitat are important for MYGR survival (Tuttle 1979). These areas serve as corridors for travel and as protective feeding cover for young bats just starting to fly (Brady et al. 1982). MYGR bats forage primarily over water where flying insects are abundant (LaVal et al. 1977) and wetlands are also important foraging sites for them (Lamb 2000). Summer colonies, especially maternity colonies, prefer caves that are within 0.6 mile (1 km) of a major river or lake and are rarely found in caves located at distances greater than 2.5 miles (4 km; Tuttle 1976). MYGR bats may roost at man-made sites that simulate summer caves, such as abandoned barns (Gunter and Elder 1971) and storm drains (Timmerman and McDaniel 1992). The storm drains may replicate the high humidity and clear running water characteristic of natural caves used by this species (Mitchell and Martin 2002).

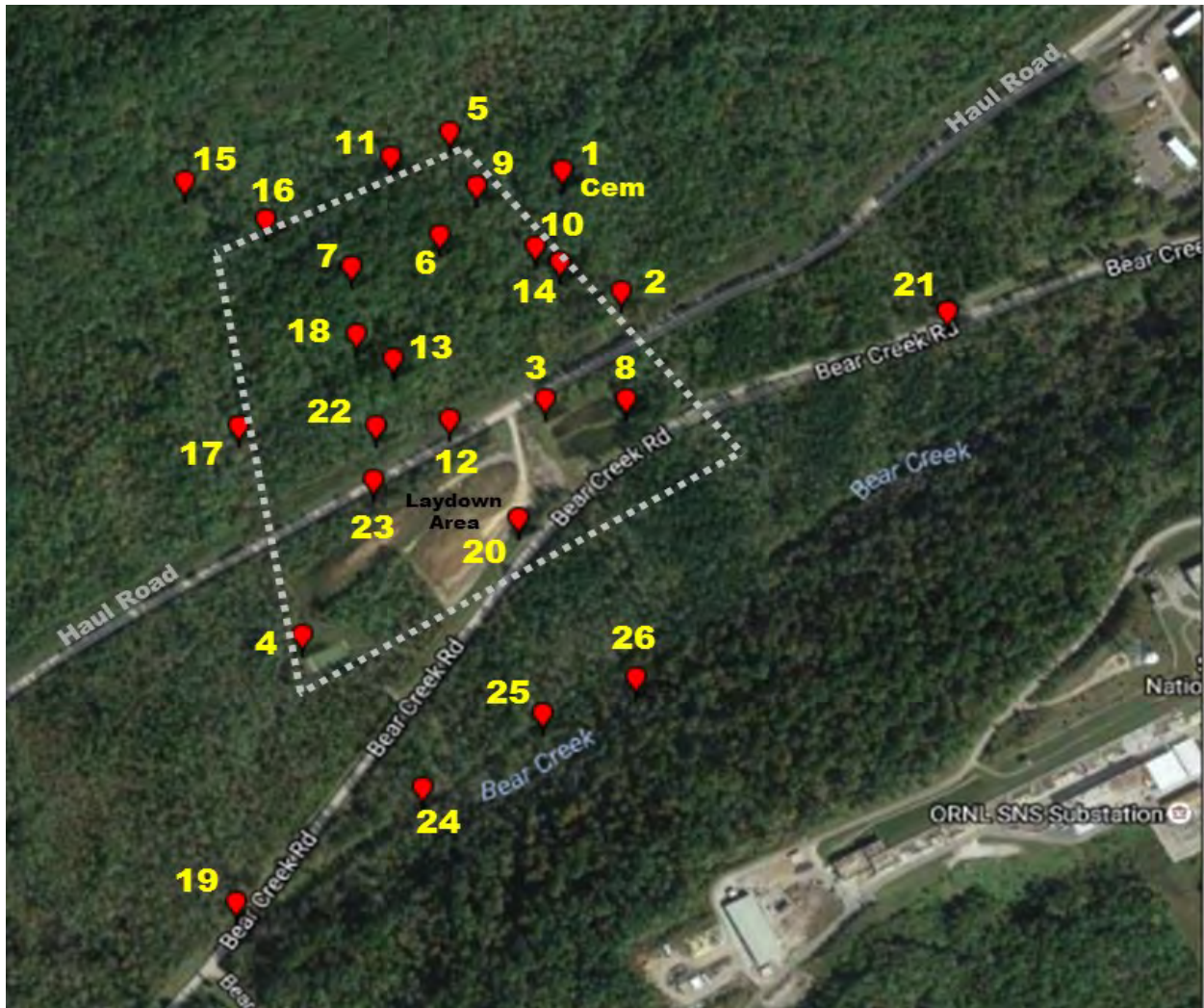
## Study Site

TDEC conducted an acoustic bat survey at the proposed EMDF site 7a/7c ("EMDF") situated in Bear Creek Valley on the ORR. Stratigraphic units underlying the general area include the Cambrian Rome Formation (i.e., thick beds of maroon, fine-grained, sandstone with occasional interbeds of maroon shale and thin siltstone bands) and Conasauga Group (i.e., Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale, and the Maynardville Limestone). The topography to the immediate north of the proposed site is dominated by Pine Ridge, which is underlain by rocks of the Rome Formation and characterized by steep slopes and gaps that give the ridge a "saw-tooth" appearance (Jacobs 1998). The approximate 90 acre (36.4 hectares) footprint of the hilly and dissected terrain of the site is covered by an oak-hickory-beech forest and bounded by two main hollows, NT-10 (North Tributary 10) on the east side and NT-11 (North Tributary 11) on the west side. The proposed site is bounded to the south by the Haul Road and to the north by Pine Ridge. There are wetlands in both north tributaries, which existed prior to the construction of the Haul Road. Each of these wetlands contain colonies of the Tennessee-listed Northern Tubercled Rein-orchid (*Platanthera flava* var. *herbiola*; threatened species).

Bat acoustic monitoring sites were selected in areas of suitable bat habitat based upon satellite imagery, topographic maps, and additional sites identified in the field such as linear flight corridors (i.e., access roads, field/forest edge, utility right-of-way, stream riparian zones) and roosting/foraging habitats (i.e., rocky outcrops, trees with loose bark such as white oaks, dead standing trees, open forest canopy, ponds, wetlands and karst features).

Bat detectors were initially deployed on August 25, 2016, and the last detectors were deployed on September 14, 2016; all detectors were removed from the site on September 27, 2016. These deployment dates were beyond the recommended survey season per the "Rangewide Indiana Bat Summer Survey Guidelines" (May 15—August 15; USFWS 2016a). Hence, TDEC recommends DOE conduct additional acoustic surveys and a habitat assessment between May and August prior to tree removal at the proposed EMDF site.

Bats were monitored at 26 field stations on the proposed EMDF (Map 1 and Table 1) by conducting acoustic surveys to record bat echolocation calls using acoustic bat detectors. Field deployments varied from four to 13 nights; the USFWS guidelines recommend a minimum of four detector nights per 0.20 mile<sup>2</sup> (0.5 km<sup>2</sup>) of suitable summer habitat.



Map 1: Acoustic Survey Sites at the Proposed EMDF Site 7a/7c  
 (Red dots = acoustic survey sites; Yellow numbers = survey site numbers; White dashed line = approximate EMDF footprint boundary)

site	latitude	longitude	deployment date	Anabat Detector Type	nights deployed	acoustic survey site description
1	35.95779	-84.30965	8/25/2016	Express	4	Douglas Chapel Cemetery / open canopy in oak-hockory forest
2	35.95655	-84.30894	8/25/2016	Express	4	Small wetland, north of Haul Road
3	35.95542	-84.30984	8/25/2016	Express	5	Constructed wetland (west side), laydown area
4	35.95299	-84.31266	8/29/2016	Express	5	Catchment pond, laydown area
5	35.95818	-84.31096	8/29/2016	Express	5	Small stream drainage hollow; forest west of cemetery
6	35.95713	-84.31106	8/29/2016	SD-02	5	Ridgetop, white oak-hickory forest
7	35.95679	-84.31210	8/29/2016	SD-02	9	Ridgetop, white oak-hickory forest
8	35.95544	-84.30891	8/29/2016	SD-02	5	Constructed wetland (east side), laydown area
9	35.95763	-84.31063	9/2/2016	Express	13	Small stream drainage hollow; forest southwest of cemetery
10	35.95700	-84.30995	9/2/2016	Express	12	Small stream drainage hollow; forest southwest of cemetery
11	35.95794	-84.31164	9/2/2016	Express	13	Forested topographic saddle, north fringe of EMDF footprint
12	35.95523	-84.31095	9/2/2016	Express	13	Haul Road near laydown area (open)
13	35.95585	-84.31162	9/2/2016	Express	11	Ridgetop, white oak-hickory forest
14	35.95684	-84.30967	9/2/2016	SD-02	9	Small stream drainage hollow; forested wetland area.
15	35.95768	-84.31406	9/6/2016	Express	8	Large forested drainage hollow, northwest of EMDF footprint
16	35.95729	-84.31309	9/6/2016	Express	7	Large white oaks, northwest section of EMDF footprint
17	35.95515	-84.31342	9/6/2016	Express	10	Forested stream drainage hollow, west side of site
18	35.95609	-84.31205	9/6/2016	SD-02	10	Small forested hollow between two ridges, west side
19	35.95025	-84.31344	9/8/2016	Express	7	Bear Creek Road bridge at forest edge (open), west of EMDF footprint
20	35.95421	-84.31016	9/8/2016	Express	7	South side of laydown area (open) adjacent to Bear Creek Road
21	35.95634	-84.30516	9/9/2016	Express	8	Bear Creek Road at forest edge (open), east of EMDF footprint
22	35.95516	-84.31181	9/14/2016	Express	13	Field/forest edge north of the Haul Road / powerline right-of-way
23	35.95459	-84.31185	9/14/2016	Express	13	North boundary of laydown area at Haul Road/pre-Manhattan homesite
24	35.95142	-84.31128	9/14/2016	Express	13	South of EMDF footprint / old utility right-of-way near Bear Creek (open)
25	35.95218	-84.30988	9/14/2016	Express	13	South of EMDF footprint / small beaver dam in Bear Creek riparian zone
26	35.95256	-84.30879	9/14/2016	Express	13	South of EMDF footprint / large wetland in Bear Creek impounded by beaver dam

Table 1: TDEC Acoustic Survey—Field Site Information (Coordinates recorded in World Geodetic System 1984 - WGS 84)

## Methods

Bat detector units were deployed at potential EMDF bat habitats such as foraging areas and flight corridors on the study site and mounted as high above ground level as possible (2 to 3 meters) to minimize ground clutter and insect noise. For this project, TDEC deployed the following bat detectors: (1) Anabat SD-2 plus detachable microphone (Titely Scientific, Columbia, MO) and (2) Anabat Express with self-contained microphone (Titely Scientific, Columbia, MO) to record bat echolocation calls at each study site (see Figures 1 through 6). The Anabat detector uses a frequency-division system for transforming ultrahigh frequency sound by reducing the number of cycles while recording the entire range of bat frequency sweeps in real-time (Frick 2013). Anabat detectors were pre-programmed to record bat calls from 30 minutes before dusk and until 30 minutes past dawn during each night of recording. Bat call files were recorded and saved on SanDisk® memory cards installed within each detector.

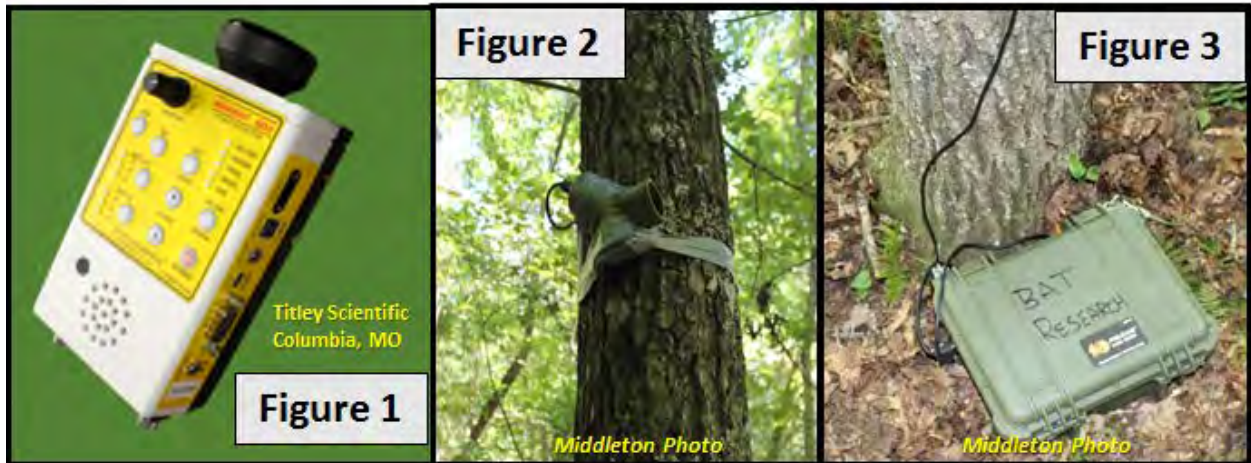
Bat calls can generally be classed into two groups: (1) narrowband calls (sometimes referred to as Constant Frequency, or CF, calls) are those of almost constant frequency, and (2) broadband calls (sometimes referred to as Frequency Modulation, or FM, calls) sweep a large range of frequencies in a very short time (Schnitzler & Kalko 2001). Broadband calls are used to scan the landscape (for localization and distance to target) while narrowband calls are used to provide information on



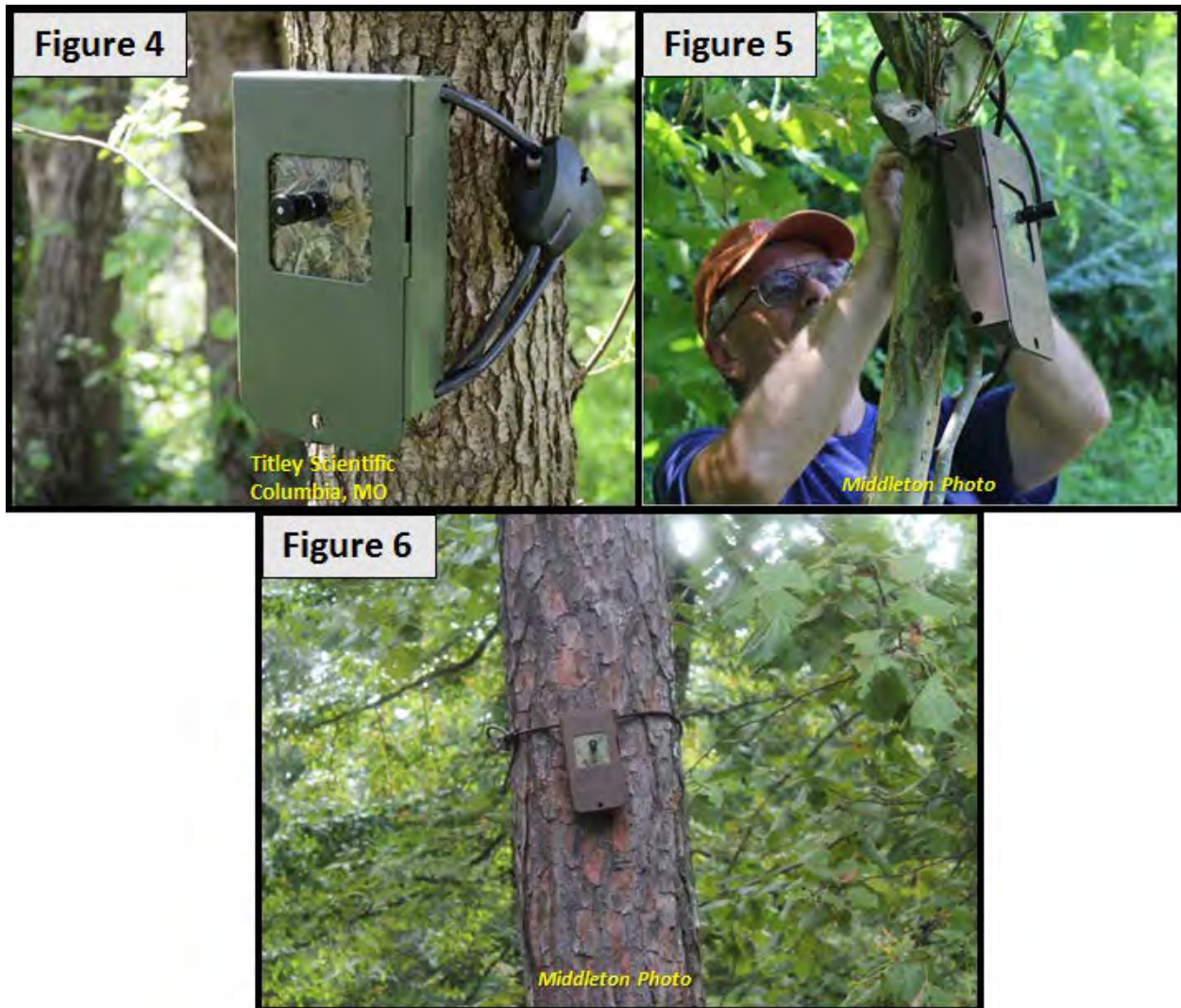
potential prey items (finds fluttering insects and long-range detection of Doppler-shifted echoes; Moss and Surlykke 2010). Echolocating bats emit signals of ultrahigh frequency and analyze the returning echoes to detect, characterize, and localize the reflected objects, hence a form of sonar (Schnitzler and Kalko 2001). Bat echolocation calls (ultrasonic vocalizations) vary in their dominant frequency approximately between 11 (kilohertz) kHz (Fullard & Dawson 1997) and 212 kHz (Fenton & Bell 1981) emitted as a series of frequency sweeps used for navigation and hunting prey. For example, the sonar broadcasts of Big Brown bats sweep downward from about 110 to 20 kHz in several harmonics within a couple of seconds (Hiryu et al. 2010). Each sonar broadcast impinges on objects at different distances to form a stream of echoes returning at different delays. Bats determine the distance to objects from the delay of echoes that the bat detects during the interval that follows each broadcast (Hiryu et al. 2010).

Bat call data saved on Anabat detector memory cards were downloaded using CFC-Read and Analook-W post-processing software (Titley Scientific, Inc., Columbia, MO). Then the downloaded data were analyzed by Kaleidoscope PRO (Wildlife Acoustics, Inc., Maynard, MA) which compares each unknown recorded call to a built-in library suite of species-specific calls (McCracken et al. 2015). So, in this manner, the unknown calls are identified to species. This method of comparison and analysis decreases chances of false positive identifications, but allows overlapping calls or calls which contain noise (e.g., non-bat sounds produced by insects, storms, and vehicles) to be rejected as NOID (i.e., no identification), or calls unidentifiable to species (McCracken et al. 2013). Kaleidoscope Pro also includes a package of automated classifiers for U.S. bat species to allow quick identification of species from a batch of unknown call files (Agranat 2015). When files have been processed using the chosen classifiers, the results output is presented in a Microsoft® Excel file in the chosen output directory. Kaleidoscope PRO also determines the maximum likelihood of presence or absence for each classified call by calculating the p-value corresponding to the null hypothesis of absence (Britzke et al. 2002). A low p-value (<0.05) suggests presence, but bat identifications with a high p-value (>0.05) would suggest that a particular bat as detected by Kaleidoscope PRO software is likely absent. A high p-value is not proof of absence; it simply means there is not sufficient statistical evidence of presence (Agranat 2015).

The project followed the bat acoustic survey guidance and protocols of Britzke et al. (2011), Ford et al. (2005), Jones et al. (2004), Kuenzi and Morrison (1998), Manley et al. (2006), Murray et al. (1999), and the USFWS (2016a).



Figures 1 through 3: Anabat SD-2 detector showing microphone and lockbox deployments



Figures 4 through 6: Anabat Express detector deployment examples

## Results and Discussion

During the late summer of 2016 (August-September), TDEC monitored and recorded bat echolocation calls at 26 survey stations at the proposed EMDF (Site 7a/7c). TDEC monitored areas such as a pond, forested ridgetops, stream riparian zones, field/forest edge, wetlands, and linear features (i.e., utility right-of-way, access roads). Anabat detectors were used to passively monitor (i.e., unattended survey) and record acoustic data over a period of four to 13 consecutive nights from dusk until dawn. Multiple-night data ( $\geq$ four nights) were grouped together (i.e., composited) for each monitoring site to present the data as the total number of bat-calls detected per species.

Approximately 185,849 files of field acoustic data were recorded during the 2016 survey. These acoustic files were ultimately processed with the Kaleidoscope PRO bat identification software (version 4.0.0). The results of the software output indicated that, of the 17 bat species known to occur in Tennessee, 14 bat species were indicated at the site (Table 2). However, some of the detected species had reported p-values  $>0.05$  suggesting there is insufficient statistical evidence of presence. Generally, a high p-value  $>0.05$  indicates that the detected bat species may not actually be present; a low p-value  $<0.05$  indicates likely presence of an identified species.

A total of 16,202 bat calls were identified to species and an additional 2,409 bat calls were detected, but not identified to species. Numerous noise files ( $n=167,238$ ) were also detected due to chorusing insects, weather (i.e., wind, thunderstorms), and anthropogenic noise (Table 3). The EMDF sites with the major number of bat calls included: (a) site 3 with 1,530 total bat calls, (b) site 4 with 2,201 total bat calls, (c) site 12 with 1,150 total bat calls, (d) site 15 with 946 total bat calls, (e) site 19 with 1,136 total bat calls, (f) site 20 with 880 total bat calls, (g) site 22 with 908 total bat calls, (h) site 23 with 3,271 total bat calls, and (i) site 24 with 1,262 total bat calls (see Table 1 for site descriptions and Map 1 for survey locations).

Survey site 23, which had the greatest number of bat calls recorded ( $n=3,271$  bat calls), is located at a pre-Manhattan home site on the north fringe of the laydown area adjacent to the Haul Road. A “laydown area” is an area of ground located near or at the construction site that is for the receipt, storage, and partial assembly of project equipment and materials to be installed or constructed. The Anabat Express detector microphone was oriented south into the open space of the laydown area. The reason for the high concentration of bat activity at this site may be due to area associated with the laydown facility (i.e., forest/field edge) and a large nearby pond providing bats with a large open area to forage for insects and drink water. The next largest group of bat calls was recorded at site 4 ( $n=2,201$  bat calls) which is located at the large catchment pond on the southwest corner of the laydown area. The third largest group of bat calls was recorded at site 3 ( $n=1,530$  bat calls) which is located at a constructed wetland on the southeast side of the laydown area. The fourth largest group of bat calls was recorded at site 24 ( $n=1,262$  bat calls) which is located at an open canopy, old utility right-of-way at Bear Creek situated south of the footprint of the proposed EMDF site. Site 24 is significant because this site is where the largest number of T&E bat calls were recorded ( $n=106$  MYGR calls).

During the habitat survey of the proposed EMDF site, potential bat roosting trees were documented including white oaks with loose bark and numerous dead standing trees (snags) but no caves were observed. However, Walker Branch Cave and Unnamed Cave #2 are located within 1.5 miles of the site, and Handshake Hole Cave and Bill's New Cave are located within 2.5 miles. The status of bat populations in these caves is currently unknown.

Tennessee Species: Common name	Tennessee Species: Scientific name (acronym)	Acoustic detection at Proposed EMDF 7a/7c	Tennessee status	Federal status
Big Brown bat	<i>Eptesicus fuscus</i> (EPFU)	yes	Not listed	Not listed
Eastern Red bat	<i>Lasiurus borealis</i> (LABO)	yes	Not listed	Not listed
Hoary bat	<i>Lasiurus cinereus</i> (LACI)	yes	Not listed	Not listed
Seminole bat	<i>Lasiurus seminolus</i> (LASE)	no	Not listed	Not listed
Silver-haired bat	<i>Lasionycteris noctivagans</i> (LANO)	yes	Not listed	Not listed
Gray bat	<i>Myotis grisescens</i> (MYGR)	yes	Endangered	Endangered
Eastern Small-footed bat	<i>Myotis leibii</i> (MYLE)	yes	Need of management	Not listed
Little Brown bat	<i>Myotis lucifugus</i> (MYLU)	yes	Not listed	Not listed
Southeastern bat	<i>Myotis austroriparius</i> (MYAU)	yes	Not listed	Not listed
Northern Long-eared bat	<i>Myotis septentrionalis</i> (MYSE)	yes	Not listed	Threatened
Indiana bat	<i>Myotis sodalis</i> (MYSO)	yes	Endangered	Endangered
Evening bat	<i>Nycticeius humeralis</i> (NYHU)	yes	Not listed	Not listed
Rafinesque's Big-eared bat	<i>Corynorhinus rafinesquii</i> (CORA)	no	Need of management	Not listed
Townsend's Big-eared bat	<i>Corynorhinus townsendii</i> (COTO)	yes	Not listed	Not listed
Virginia Big-eared bat	<i>Corynorhinus (=Plecotis) townsendii virginianus</i> (COVA)	no	Not listed	Endangered
Tri-colored bat	<i>Perimyotis subflavus</i> (PESU)	yes	Not listed	Not listed
Mexican Free-tailed bat	<i>Tadarida brasiliensis</i> (TABR)	yes	Not listed	Not listed

**Table 2: Tennessee bat species detected at the proposed EMDF site 7a/7c**

**Note:** green-highlighted rows indicate T&E species that were detected.

	SUMMARY OF BAT SPECIES CALLS RECORDED (FOR ALL 26 SITES COMBINED)														OTHER OUTPUT	
SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
NUMBER OF BAT CALLS	16	3755	2368	3772	3792	64	179	9	140	5	4	659	1111	328	2409	167238

**Table 3: Acoustic data summary: number of bat calls detected per species**

**Notes:** •Numbers in each box = the number of bat calls recorded per species, not the number of bats recorded; •NOID = bat calls were detected but not identified to species due to poor call quality; •NOISE = Non-bat sounds such as insect noise, weather (storms), and anthropogenic mechanical noise; •green highlight = threatened and endangered species.

**Bat species codes:** COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat).

Table 4a-4e reports the raw data results from the Kaleidoscope PRO automated software output for each EMDF monitoring site. Figure 7 characterizes the bat species population based upon the composited recordings by species for all 26 survey locations. The dominant bat species recorded at the proposed EMDF site was the Silver-haired bat detected at 23 of 26 survey sites ( $n=3,792$  calls recorded), followed by Hoary bat detected at 25 of 26 sites surveyed ( $n=3,772$  calls recorded), Big Brown bat detected at 19 of 26 sites surveyed ( $n=3,755$  calls recorded), the Eastern Red bat detected at 24 of 26 sites surveyed ( $n=2,368$ ), and the Tri-colored bat detected at 17 of 26 sites surveyed (also known as-Eastern Pipistrelle, 1,111 calls recorded). The relatively low number of bat calls reported in Table 7 for the T&E bat species (MYGR, MYSE, MYSO) may be due to the less-than-optimal timing of the field survey. For example, Indiana bat females would have completed rearing their pups and likely migrated to their fall swarming areas (near caves) during September and October. At the time of the survey, juvenile bats would not be volant, hence low detection numbers.

It is important to tease out information from the bat call analysis output especially for the *Myotis* genus. The dominant T&E species detected on the EMDF site was the MYGR bat detected at 14 of 26 sites surveyed ( $n=179$  calls recorded), the MYSE bat detected at five of 26 sites surveyed ( $n=$ five calls), and the MYSO bat detected at three of 26 sites surveyed ( $n=$ four calls). Although the results for the MYGR bat calls were characterized by low p-values (p-value:  $<0.05$ ), the high p-values ( $>0.05$ ) reported for the endangered MYSO bat and the threatened MYSE bat were not robust. Compared to the other taxa detected on the EMDF site, *Myotis* bats comprised about 2% of the total bat calls detected (Figure 8). This outcome is likely due to the late seasonal schedule of this survey; that is, TDEC surveyed outside of the May 15 through August 15 recommended acoustic survey window as suggested by the USWFS. Thus, it is possible that during the time of this acoustic survey the MYSO and MYSE bats left their summer roost tree habitats (Figures 9 through 11) and either migrated or were in process of migration to their respective fall swarming, feeding and mating locations, most likely near cave hibernacula.

Other species recorded at the proposed EMDF include the Southeastern bat (p-value:  $<0.05$ ) detected at 19 of 26 sites surveyed ( $n=64$  calls recorded). McCracken et al. (2015) reports that the Southeastern bat, whose range includes southern Tennessee, has not been previously recorded with acoustics nor captured in mist-netting surveys on the ORR. Additional species included the Eastern Small-footed bat detected at six of 26 sites surveyed ( $n=$ nine calls recorded), the Evening bat detected at 15 of 26 sites surveyed ( $n=659$  calls recorded), the Mexican Free-tailed bat was detected at 22 of 26 sites surveyed ( $n=328$  calls recorded), and Townsend's big-eared bat was detected at seven of 26 sites surveyed ( $n=16$  calls recorded).

The Eastern Small-footed bat is a species listed by the TDEC Division of Natural Areas as "in need of management" and as a federal "species of concern" due to WNS and habitat loss. Interestingly, the ORR is not in the Townsend's Big-eared bat range (McCracken et al. 2015).



KALEIDOSCOPE 4.0.0 (Output) Bats of North America		NUMBER OF BAT CALLS DETECTED PER SPECIES														ADDITIONAL OUTPUT	
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-01	# OF BAT CALLS			27	3	4		1		3			1	3	2	4	2327
	PRESENCE P-VALUES			0	0.021152	0.153938		0.151637		0.853299			1	0.137109	0.381586		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-02	# OF BAT CALLS		94		323	18								3	2	108	33304
	PRESENCE P-VALUES		0		0	1								1.73E-05	1		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-03	# OF BAT CALLS		322	156	877	74	3	2	2	34			27	27	6	277	13732
	PRESENCE P-VALUES		0	0	0	1	7.2E-06	0.316843	0.000199	0.000159			1	0	1		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-04	# OF BAT CALLS	1	721	90	1102	176	7	1		23	1		18	52	9	607	21829
	PRESENCE P-VALUES	1	0	0	0	1	3E-07	1		0.00333	1		1	0	1		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-05	# OF BAT CALLS			1	1	4									6	2	91
	PRESENCE P-VALUES			0.229947	0.916585	0.065779									4.53E-05		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-06	# OF BAT CALLS			2			1							1		3	5596
	PRESENCE P-VALUES			0.063223			0.08447							0.148911			

**Table 4a: Total number of bat calls recorded for each species per survey site**

**Notes:** •Numbers in each column box = the number of bat calls recorded per species, not the number of bats recorded; •Empty boxes = no bat calls recorded for the species indicated; •NOID = bat calls were detected but not identified to species due to poor call quality; •NOISE = Non-bat sounds such as insect noise, weather (storms), and anthropogenic mechanical noise; •Green highlight = threatened and endangered species; •Presence p-values: <0.05 = species likely present; >0.05 = insufficient statistical evidence to support presence of this particular species (but bats were detected).

**Bat species codes:** COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat).

KALEIDOSCOPE 4.0.0 (Output) Bats of North America		NUMBER OF BAT CALLS DETECTED PER SPECIES														ADDITIONAL OUTPUT	
SURVEY SITE #	SPECIES		EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-07	# OF BAT CALLS			1	1	1	2									0	4858
	PRESENCE P-VALUES			0.207201	0.106864	0.683762	0.007135										
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-08	# OF BAT CALLS	1	171	61	215	72	3	3		6			12	32	3	103	22708
	PRESENCE P-VALUES	1	0	0	0	1	0.00049	0.003231		1			1	0	1		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-09	# OF BAT CALLS		4	10	110		1						1			35	12099
	PRESENCE P-VALUES		1	5E-07	0		0.08374						1				
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-10	# OF BAT CALLS		1	26	40	14	3								21	121	839
	PRESENCE P-VALUES		1	0	0	0.884479	0.000598								0		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-11	# OF BAT CALLS			1	5	3	3								1	7	1786
	PRESENCE P-VALUES			0.210927	9.72E-05	0.624429	0.000603								0.817325		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-12	# OF BAT CALLS		203	154	280	237	4	9		12		2	95	141	13	232	9169
	PRESENCE P-VALUES		0	0	0	0	0.00096	0		1		1	1E-07	0	1		

**Table 4b (continued): Total number of bat calls recorded for each species per survey site**

**Notes:** •Numbers in each column box = the number of bat calls recorded per species, not the number of bats recorded; •Empty boxes = no bat calls recorded for the species indicated; •NOID = bat calls were detected but not identified to species due to poor call quality; •NOISE = Non-bat sounds such as insect noise, weather (storms), and anthropogenic mechanical noise; •Green highlight = threatened and endangered species; •Presence p-values: <0.05 = species likely present; >0.05 = insufficient statistical evidence to support presence of this particular species (but bats were detected).

**Bat species codes:** COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat).



KALEIDOSCOPE 4.0.0 (Output) Bats of North America		NUMBER OF BAT CALLS DETECTED PER SPECIES														ADDITIONAL OUTPUT		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE	
EMDF-13	# OF BAT CALLS			1	1	11								1		2	3	4250
	PRESENCE P-VALUES			0.603014	0.544844	1.9E-06								0.594882		0.479913		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE	
EMDF-14	# OF BAT CALLS		24	5	156	17	1								4	32	14742	
	PRESENCE P-VALUES		0.000088	0.00037	0	1	0.083513								1			
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE	
EMDF-15	# OF BAT CALLS	2	454	62	6	289		1		1			71	45	15	25	641	
	PRESENCE P-VALUES	0.954708	0	0	1	0		1		1			0	0	1			
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE	
EMDF-16	# OF BAT CALLS				2											1	10	
	PRESENCE P-VALUES				0.013311													
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE	
EMDF-17	# OF BAT CALLS		1	3	14	6	4								1	9	1138	
	PRESENCE P-VALUES		1	0.008526	0	0.566712	4.92E-05								1			
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE	
EMDF-18	# OF BAT CALLS		1	6	5	5	1			1				3	2	3	809	
	PRESENCE P-VALUES		1	0.000261	0.000436	0.139974	0.084672			0.886554				0.003797	0.448491			

**Table 4c (continued): Total number of bat calls recorded for each species per survey site**

**Notes:** •Numbers in each column box = the number of bat calls recorded per species, not the number of bats recorded; •Empty boxes = no bat calls recorded for the species indicated; •NOID = bat calls were detected but not identified to species due to poor call quality; •NOISE = Non-bat sounds such as insect noise, weather (storms), and anthropogenic mechanical noise; •Green highlight = threatened and endangered species; •Presence p-values: <0.05 = species likely present; >0.05 = insufficient statistical evidence to support presence of this particular species (but bats were detected).

**Bat species codes:** COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat).

KALEIDOSCOPE 4.0.0 (Output) Bats of North America		NUMBER OF BAT CALLS DETECTED PER SPECIES														ADDITIONAL OUTPUT	
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-19	# OF BAT CALLS	3	146	184	124	522		7		2			79	37	32	120	1019
	PRESENCE P-VALUES	0.132417	2.4E-06	0	0	0		3.8E-06		1			0.000168	0	1		
EMDF-20	# OF BAT CALLS		249	88	381	93	2	4	2	2	1	1	24	25	8	161	10013
	PRESENCE P-VALUES		0	0	0	1	0.01001	0.000744	0.002325	1	0.70341	0.725898	1	0	1		
EMDF-21	# OF BAT CALLS		38	87	38	52	5	4		5	1		40	60	5	82	3281
	PRESENCE P-VALUES		1E-07	0	0	0	3.24E-05	0.000374		1	0.910813		0.017867	0	1		
EMDF-22	# OF BAT CALLS		71	265	31	329	4	36	1	12	1		29	38	91	115	955
	PRESENCE P-VALUES		0.050874	0	0	0	0.003484	0	0.045321	1	1		1	0	0		
EMDF-23	# OF BAT CALLS	1	1200	204	18	1611	4	1	1	2	1	1	183	12	42	59	163
	PRESENCE P-VALUES	1	0	0	1	0	1.25E-05	0.891501	1	1	1	0.9778	0	0.521524	1		
EMDF-24	# OF BAT CALLS		19	805	28	82	5	106	2	14			74	103	24	220	1193
	PRESENCE P-VALUES		1	0	0	0	0.000168	0	0.000749	1			1	0	0.297494		

**Table 4d (continued): Total number of bat calls recorded for each species per survey site**

**Notes:** •Numbers in each column box = the number of bat calls recorded per species, not the number of bats recorded; •Empty boxes = no bat calls recorded for the species indicated; •NOID = bat calls were detected but not identified to species due to poor call quality; •NOISE = Non-bat sounds such as insect noise, weather (storms), and anthropogenic mechanical noise; •Green highlight = threatened and endangered species; •Presence p-values: <0.05 = species likely present; >0.05 = insufficient statistical evidence to support presence of this particular species (but bats were detected).

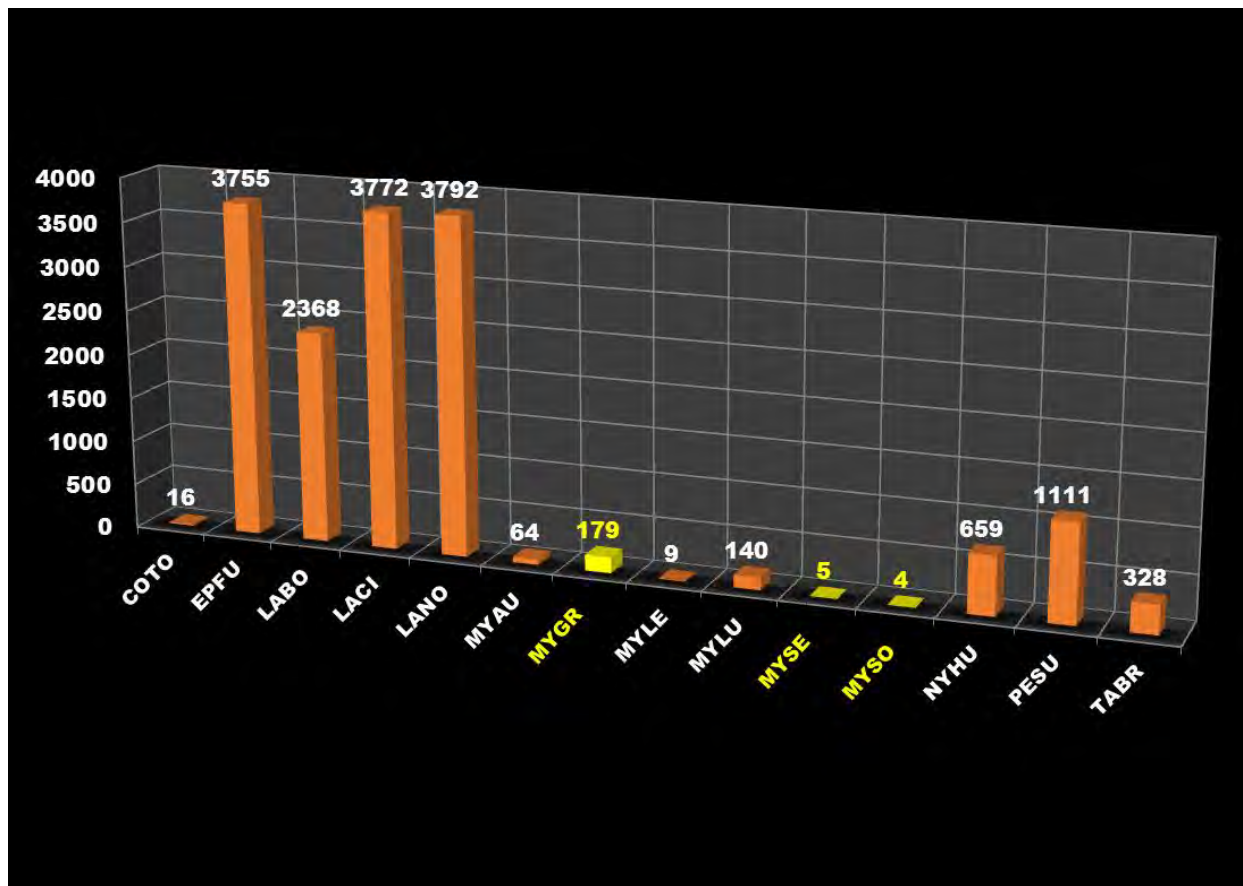
**Bat species codes:** COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat).

KALEIDOSCOPE 4.0.0 (Output) Bats of North America		NUMBER OF BAT CALLS DETECTED PER SPECIES														ADDITIONAL OUTPUT	
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-25	# OF BAT CALLS	1	28	100	10	130	9	3	1	22			4	5	28	59	585
	PRESENCE P-VALUES	0.473219	0.785856	0	0.02166	0	0	0.007722	0.083423	0.000482			1	0.484547	8.64E-05		
SURVEY SITE #	SPECIES	COTO	EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	NYHU	PESU	TABR	NOID	NOISE
EMDF-26	# OF BAT CALLS	7	8	29	1	42	2	1		1				524	11	21	101
	PRESENCE P-VALUES	0	0.831146	1	1	0	0.007159	0.00744		1				0	0.001236		

**Table 4e (continued): Total number of bat calls recorded for each species per survey site**

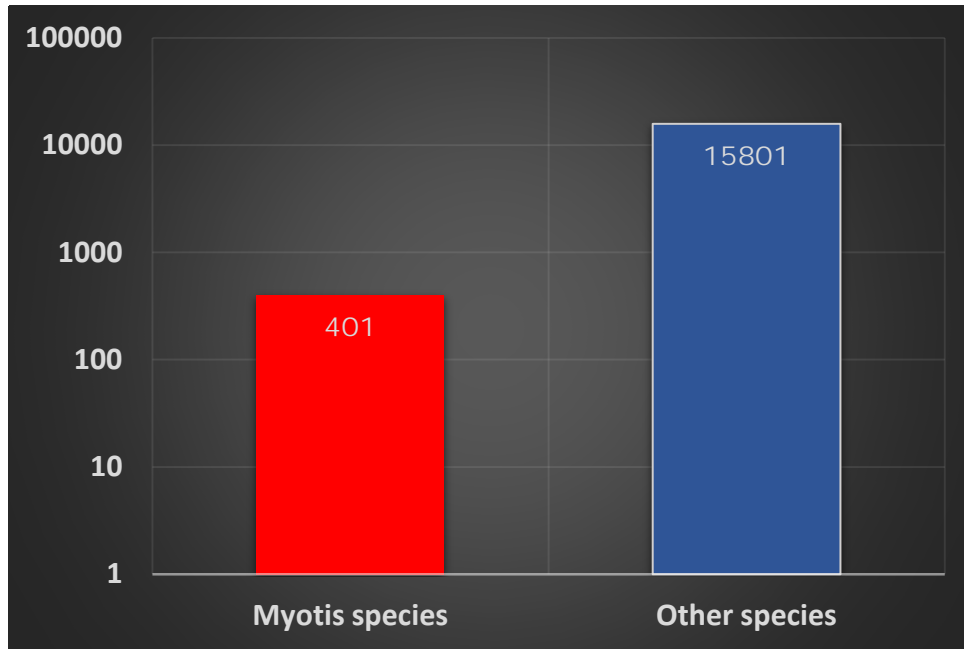
**Notes:** •Numbers in each column box = the number of bat calls recorded per species, not the number of bats recorded; •Empty boxes = no bat calls recorded for the species indicated; •NOID = bat calls were detected but not identified to species due to poor call quality; •NOISE = Non-bat sounds such as insect noise, weather (storms), and anthropogenic mechanical noise; •Green highlight = threatened and endangered species; •Presence p-values: <0.05 = species likely present; >0.05 = insufficient statistical evidence to support presence of this particular species (but bats were detected).

**Bat species codes:** COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat).



**Figure 7: Total number of bat calls recorded per species at the proposed EMDF site 7a/7c (combined species data for all 26 survey stations)**

BAT SPECIES CODES: COTO = *Corynorhinus townsendii* (Townsend's Big-eared Bat), EPFU = *Eptesicus fuscus* (Big Brown Bat), LABO = *Lasiurus borealis* (Eastern Red Bat), LACI = *Lasiurus cinereus* (Hoary Bat), LANO = *Lasionycteris noctivagans* (Silver-haired Bat), MYAU = *Myotis austroriparius* (Southeastern Myotis), MYGR = *Myotis grisescens* (Gray Bat, endangered species), MYLE = *Myotis leibii* (Eastern Small-footed Bat), MYLU = *Myotis lucifugus* (Little Brown Bat), MYSE = *Myotis septentrionalis* (Northern Long-eared Bat, threatened species), MYSO = *Myotis sodalis* (Indiana Bat, endangered species), NYHU = *Nycticeius humeralis* (Evening Bat), PESU = *Perimyotis subflavus* (Tricolored Bat; Eastern Pipistrelle), TABR = *Tadarida brasiliensis* (Brazilian Free-tailed bat). Yellow highlighted numbers/letters = threatened and endangered species.



**Figure 8: Myotis calls compared to other bat calls detected at the proposed EMDF site 7a/7c (Log scale; combined species data for all 26 survey stations)**

## Summary of Findings at Proposed EMDF Site 7a/7c

- TDEC recorded bat calls at 26 survey stations with Anabat detectors
- Detectors were pre-programmed to record bat calls from dusk until dawn
- Wetlands, oak-hickory-beech forest, laydown area, stream riparian zones, linear features (trails, roads), field/forest edge, and a pond were monitored
- Recorded 185,849 acoustic files collected during 235 combined survey nights
- 167,238 noise files processed (insect, weather, and anthropogenic noise detected)
- 16,202 bat species identified; an additional 2,409 bats were detected but not identified to species by the software
- 14 of the 17 bat species known to occur in TN were indicated (COTO, EPFU, LABO, LACI, LANO, MYAU, MYGR, MYLE, MYLU, MYSE, MYSO, NYHU, PESU, TABR)
- EPFU, LABO, LACI, and LANO were the predominant species indicated at the EMDF site
- A combined total of 401 *Myotis* species bat calls (2% of all bat calls) were recorded at the site (*Myotis* are mainly cave bats)
- T&E species detected at the site include the following:
  - Gray bat (endangered) detected at 14 of 26 sites surveyed ( $n=179$  calls recorded)
  - Northern Long-eared bat (threatened) detected at five of 26 survey sites ( $n=$ five calls)
  - Indiana bat (endangered) detected at three of 26 sites surveyed ( $n=$ four calls recorded)
- Other species detected at the site include the following:
  - Mexican Free-tailed bat was detected at 22 of 26 survey sites ( $n=328$  calls)
  - Little Brown bat detected at 15 of 26 sites surveyed ( $n=140$  calls recorded)
  - Townsend's Big-eared bat detected at seven of 26 survey sites ( $n=16$  calls recorded); this bat has not been previously recorded nor captured on the ORR
  - Eastern Small-footed bat detected at six of 26 sites surveyed ( $n=$ nine calls recorded)
- Survey sites with the greatest density of combined bat calls were recorded in the vicinity of the laydown area (wetlands and catchment pond) and at a Bear Creek/utility right-of-way open canopy site (south of the proposed EMDF footprint)

## Conclusions and Recommendations

- The TDEC bat survey detected 14 bat species at the proposed EMDF (Site 7a/7c), including three T&E species: the federally endangered Gray bat (MYGR), the federally threatened Northern Long-eared bat (MYSE), and the federally endangered Indiana bat (MYSO).
- Site 7a/7c for the proposed EMDF contains significant forest cover and small stream hollows with wetlands providing potential habitat for T&E bat species. Accordingly, TDEC strongly recommends DOE enter into early informal consultations with the USFWS to address the requirements pursuant to the Section 7(a)(2) of the Endangered Species Act of 1973. The consultation would be directed toward not committing an “incidental take” in violation of the 4(d) Rule for this threatened species, the Northern Long-eared bat.
- Seasonal timber removal should be coordinated with the USFWS during the consultation process. The USFWS has published a framework suggesting timber removal at a project site should only occur during the fall/winter season (bat hibernation period). In other words, trees should not be harvested during spring/summer season when bats are using trees (and forests) for foraging, roosting, and while females are raising their young (USFWS 2016a, 2016b, 2016c). Please refer to the following USFWS websites for further information regarding the Rule 4(d) and the Northern Long-eared bat:
  - <https://www.fws.gov/midwest/endangered/mammals/nleb/s7.html>
  - <https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/S7FrameworkNLEB17Feb2016.pdf>
- TDEC recommends DOE conduct a tree habitat assessment and summer bat survey between May 15 and August 15, 2017, before any land clearing or timber removal is initiated on the proposed EMDF site.

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