

PATERSON GREAT FALLS NATIONAL HISTORIC PARK SUMMER BAT ACOUSTIC SURVEY

Passaic County, New Jersey
May 20 – 30, 2021



1263 Claremont Rd., Carlisle, Pennsylvania 17015
Office and Fax: (717) 241-2228
Mobile: (814) 442-4246
www.batmanagement.com

Project Principal and Surveyor:
John Chengler

Qualitative Analysis of Calls:
John Chengler and Todd Sinander

Report Prepared by:
John Chengler and Todd Sinander

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Executive Summary

Bat Conservation and Management, Inc. (BCM) conducted an acoustic bat survey within Paterson Great Falls National Historic Park, a 52 acre property situated on both sides of the Passaic River in Passaic County, New Jersey (Figure 1 and 2). An acoustic survey was conducted by BCM to determine the presence or probable absence of bat species within the Project Area. This survey was conducted following the protocols outlined within the U.S. Fish and Wildlife Service (USFWS) *Range-wide Indiana Bat Survey Guidelines* (2020-2021). The Project Area was surveyed using passive acoustic monitoring stations from May 20 - 30, 2021. Four acoustic bat monitoring stations were deployed throughout the property near potential foraging and roosting habitat for a total of 28 successful detector nights. Approximately 2200 recordings were analyzed in order to determine bat species present at the time of the survey in the Project Area. From the results of this analysis and with the limitations of acoustic monitoring, the determination of probable presence of the Indiana bat or the northern long-eared bat cannot be supported and absence of the species may be assumed.

We have prepared this survey report for the use of our client's office for planning purposes in accordance with generally accepted bat acoustic monitoring practices and USFWS guidelines. No other warranties, either expressed or implied, are made as to the professional services included in this report. This report may be considered void without the electronic attachments originally accompanying this document.

Methods

Acoustic Methods

A bat acoustic survey was conducted in accordance with the U.S. Fish and Wildlife Service *Range-wide Indiana Bat Survey Guidelines* (2020) (FWS Guidelines). The minimum level of effort specified in the FWS Guidelines for a non-linear project area is 8 monitoring nights per 123 acres. At least 2 detector locations per 123 acre area is to be sampled until at least 4 detector nights has been completed over the course of at least 2 calendar nights. A successful detector night is one monitoring device placed at one location and activated from sundown to sunrise during a night that is within the weather parameters outlined by the FWS Guidelines.

BCM deployed 4 full-spectrum Pettersson, model D500x, acoustic detectors (Pettersson Elektronik; Uppsala, Sweden), one at each site (D501-D504) (Figure 2). Monitoring devices were deployed from May 20 - 30, 2021 for 10 nights, which would produce 40 monitoring nights if no malfunctions or weather issues occurred. More details of detector settings, placement, and site metadata can be found on the Acoustic Site Data Sheets (Appendix A).

Each detector was programmed to passively record bat echolocation calls in standard, lossless, .WAV audio format, from sunset to sunrise and to make individual 4-second recordings of triggered activity each night. The resulting individual recordings ideally represent a single “pass” (fly by) from a single bat. However, if multiple bats are flying through the optimal volume of detection during the same 4-second interval, they were recorded in tandem and current software is generally unable to reliably separate two bats during automatic analysis. In addition, other non-bat sounds in the environment such as insects and birds can be recorded.

The detectors were also programmed to record an extended “log file” for each session that details when the detector switches on each night and turns off each morning. Low battery and/or full memory errors are logged if they occur, which provide the user with accurate metrics to quantify total survey hours. Metadata from the survey site was collected, which included all pertinent details about the deployment. The site-specific data was imbedded on each recorded file during the acoustic recording attribution process (Appendix A).

All recordings were off-loaded from the detectors, organized and attributed with metadata, and classified qualitatively (manually classified) by a qualified bat biologist (Appendix B) using the sonogram viewer in the SonoBat full-spectrum software program, version 4 (Joe Szewczak, Arcata CA). Because of the low bat activity and subsequent low number of recordings obtained, no automated classifier was necessary to filter data and all bat call recordings were manually assigned a classification by a qualified biologist.

Weather Data

Nightly temperature, wind, and precipitation data were compiled from the nearest weather stations in Paterson, NJ- High Mountain Observatory - KNJTOTOW4 (www.wunderground.com) and were listed in a separate electronic document (Appendix C-Weather Data). Values reflected weather data during the first five hours of each survey night. According to FWS Guidelines, the following weather conditions preclude a valid survey night if they occur in the first 5 hours of a survey night: (a) temperatures fall below 50°F (10°C); (b) precipitation, including rain and/or fog, that exceeds 30 minutes or continues intermittently; and (c) sustained wind speeds greater than 9 miles/hour (4 meters/second; 3 on Beaufort scale) for 30 minutes or more.

Results

Level of Effort and Weather

No monitoring stations experienced technical failures and all microphones were tested to be in working condition upon demobilization. Three inclement weather events occurred during the night of May 26, 28, and 29 resulting in invalid detector nights. As a result, only 28 survey nights were valid, which exceeded the 8 nights required by the FWS Guidelines (Table 1, Appendix A). All files recorded during invalid nights were nevertheless included in the species occupancy analysis.

Species Occupancy

Over 2200 files were recorded during the survey. Call quality is affected by multiple factors such as insect noise, distance a bat is from the microphone, bats recorded at the same time, non-search phase calls (i.e. social or feeding buzzes), and weather. Recordings that were determined to be noise included files with background ultrasonic sound emitted from insects, power lines, rustling of vegetation, birds, etc., with no discernible bat pulses. Recordings that included bat calls but did not contain enough high-quality call pulses to meet the parameters for qualitative manual classification to species were categorized as a low frequency unknown (< 35 kHz), high frequency unknown ($\geq$ 35 kHz), or calls with 2 or more bats in the recording. Reasons for classifying a bat call as hi (HIFU) or low (LOFU) frequency unknown typically include call distortion from ambient noise, call characteristic overlap with acoustically similar species, out of range recordings, multiple bats in a single recording, and atypical call patterns inconsistent with search-phase calls (i.e. social or feeding buzzes). Four hundred forty-eight (448) files were identified as low frequency unknown files. Thirty-nine (39) files contained hi frequency unknown bat calls (HIFU) that had ambiguous characteristics and could not be definitively classified to species. Sixty-eight (68) files included two or more individual bats in the recording. Bats often adjust their frequency and/or emit social calls when flying near other bats which often distort identifiable call characteristics. A total of 1,486 files were manually classified to four species which included the big brown bat (*Eptesicus fuscus*), Eastern red bat (*Lasiurus borealis*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*). No files were classified as being the Indiana bat (*Myotis Sodalis*) or the northern long-eared bat (*Myotis septentrionalis*).

Species diversity was low at the survey locations with the big brown bat being the dominant species detected at all four locations. As a result of this survey the determination of presence of the Indiana bat and northern long-eared bat cannot be supported and probable absence of the species may be assumed. Species manual identifications, call parameters, and qualitative manual vetting notes can be found in Appendix D, Acoustic Data: Attached Electronic Document.

Figures

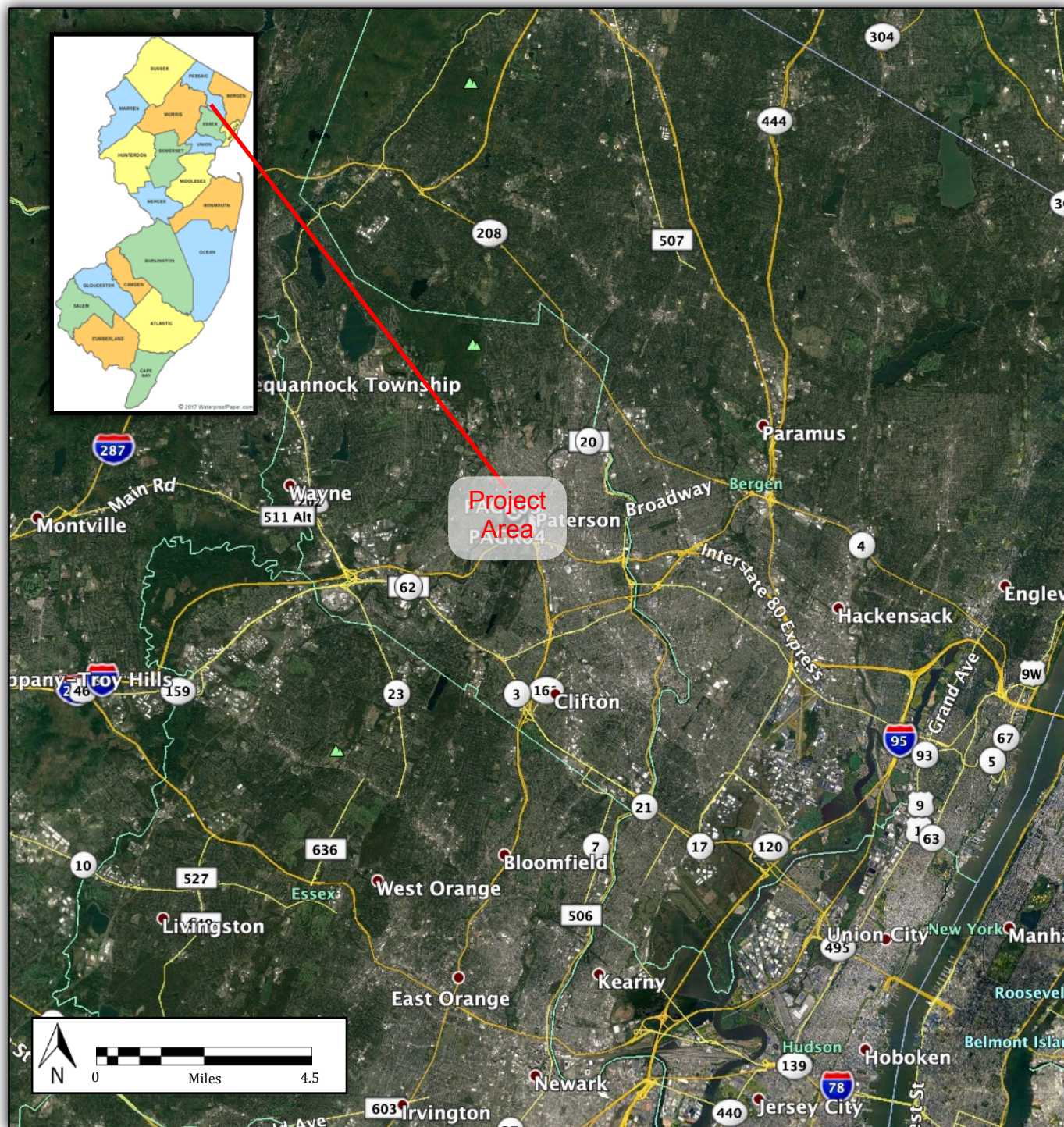


Figure 1. Project Area location

Map base layer: Google Earth



Figure 2. Project Area with detector site locations

Map base layer: Google Earth

Tables

Table 1. Detector locations and survey effort

Site	Nights Deployed	Invalid Nights		Total Valid Nights Completed
		Tech	Weather	
D501	10	0	3	7
D502	10	0	3	7
D503	10	0	3	7
D504	10	0	3	7
Total	40	0	12	28

Table 2. Qualitative classification (manual vetting) results of all call files.

Site	Date	EPFU	LABO	LACI	LANO	NYHU	HIFU	LOFU	2BAT	NOSE	Project Total
D501	20-May	2						1			3
	21-May	23					1	2	1		27
	22-May	29			5		2	6	2		44
	23-May	4					1				5
	24-May	1									1
	25-May	10	1				1	2			14
	26-May		1					1			2
	27-May	6					1				7
D501 Total		75	2	0	5	0	6	12	3	0	103
D502	23-May									1	1
	25-May	1									1
D502 Total		1	0	0	0	0	0	0	0	1	2
D503	20-May	47	3					3		1	54
	21-May	87			1		2	13	4	2	109
	22-May	92		1	1		1	21	1		117
	23-May	96	7				21	18	19	1	167
	24-May	43	7				2	4		2	53
	25-May	465			2			34	10	1	512
	27-May	115					3	12	10	1	141
D503 Total		945	17	1	4	0	29	105	44	8	1153
D504	20-May	110						33	6		149
	21-May	94					1	39	6		140
	22-May	69			1			60	4		134
	23-May	65						33	3	1	102
	24-May	37						23	1		61
	25-May	55						137	1		193
	26-May							6			6
	27-May	4	1				3				8
D504 Total		434	1	0	1	0	4	331	21	1	793
Grand Total		1455	20	1	10	0	39	448	68	10	2051

EPFU = *Eptesicus fuscus* (big brown bat), LABO = *Lasiurus borealis* (Eastern red bat), LACI = *Lasiurus cinereus* (hoary bat), LANO = *Lasionycteris noctivagans* (silver-haired bat), NYHU = *Nycticeius humeralis* (evening bat), HIFU = Files with low quality hi frequency (≥ 35 kHz) bat pulses that did not contain enough information to classify to species, LOFU = Files with low quality low frequency (< 35 kHz) bat pulses that did not contain enough information to classify to species, NOSE = files that contained no bat calls within the recoding, only ultrasonic noise from other sources.

Appendix A

Monitoring Station Records

Project: Paterson Great Falls NHP		State/County: NJ/Passaic		Site: D501		Total Valid: 7 of 10	
Lat: 40.914226°		Lon: -74.180552°		Photo: 9862-9863			
Biologist: J. Chengler, L. Braet				Detector+Firmware: 50150/2.4.5			
Elevation: 125	Mic AGL: 6m	Mic Az.: 160°	Clutter: medium	Frq: 300	Int: 0	Length: 4s	
Station Description: Mature deciduous forest along a hiking trail, at the top of a short cliff at overlooking a canal. Small park along waterways in an otherwise urban setting.							

SERVICE	TS	GAIN	TL	START	STOP	BAT	FILES	NIGHT	INVALID	INVALID WEATHER	COMMENTS
05/20/21	3	70	160	2200	607	9	n/a	n/a	n/a	n/a	Deployed
05/30/21	3	70	160	1952	600	6.7	382	10	0	3	Nominal
CLUTTER: NO = stadium-sized open meadow without vegetation or topography interfering with the airspace, LOW = large fields or other open areas bordered by hedgerows or tree lines, EDGE = significant vegetation, topography, or anthropogenic structures bordering a NO or LOW clutter open area, MED = large area with widely spaced trees and other topographic or anthropogenic structures, HIGH = understory travel corridors either along tree-covered roads or within a forested clearing or stream corridor.											



Project: Paterson Great Falls NHP				State/County: NJ/Passaic				Site: D502		Total Valid: 7 of 10	
Lat: 40.914751°				Lon: -74.179193°				Photo: 9860-9861			
Biologist: J. Chengler, L. Braet								Detector+Firmware: 50118/2.3.8			
Elevation: 95		Mic AGL: 7m		Mic Az.: 45°		Clutter: high		Frq: 300		Int: 0	
								Length: 4s			
Station Description: Top of a retaining wall overlooking a dry canal along a row of mature trees in a relatively urban setting.											
SERVICE	TS	GAIN	TL	START	STOP	BAT	FILES	NIGHT	INVALID	INVALID WEATHER	COMMENTS
05/20/21	3	70	160	2200	607	9	n/a	n/a	n/a	n/a	Deployed
05/30/21	3	70	160	1952	600	6.3	24	10	0	2	Nominal
CLUTTER: NO = stadium-sized open meadow without vegetation or topography interfering with the airspace, LOW = large fields or other open areas bordered by hedgerows or tree lines, EDGE = significant vegetation, topography, or anthropogenic structures bordering a NO or LOW clutter open area, MED = large area with widely spaced trees and other topographic or anthropogenic structures, HIGH = understory travel corridors either along tree-covered roads or within a forested clearing or stream corridor.											



Project: Paterson Great Falls NHP					State/County: NJ/Passaic					Site: D503		Total Valid: 7 of 10	
Lat: 40.917183°					Lon: -74.180762°					Photo: 9854-9865			
Biologist: J. Chenger, L. Braet										Detector+Firmware: 50245/2.3.6			
Elevation: 125		Mic AGL: 6m			Mic Az.: 180°		Clutter: medium			Frq: 300	Int: 0	Length: 4s	
Station Description: Riverside urban park with mature trees on the steep slopes. Station is on forest edge.													
SERVICE	TS	GAIN	TL	START	STOP	BAT	FILES	RUN NIGHT	INVALID	INVALID WEATHER	COMMENTS		
05/20/21	3	70	160	2200	607	9	n/a	n/a	n/a	n/a	Deployed		
05/30/21	3	70	160	1952	600	7.5	1542	10	0	3	Nominal		
CLUTTER: NO = stadium-sized open meadow without vegetation or topography interfering with the airspace, LOW = large fields or other open areas bordered by hedgerows or tree lines, EDGE = significant vegetation, topography, or anthropogenic structures bordering a NO or LOW clutter open area, MED = large area with widely spaced trees and other topographic or anthropogenic structures, HIGH = understory travel corridors either along tree-covered roads or within a forested clearing or stream corridor.													



Project: Paterson Great Falls NHP				State/County: NJ/Passaic				Site: D504		Total Valid: 7 of 10	
Lat: 40.918647°				Lon: -74.178876°				Photo: 9866-9867			
Biologist: J. Chenger, L. Braet								Detector+Firmware: 50164/2.3.8			
Elevation: 60		Mic AGL: 6m		Mic Az.: 200°		Clutter: medium		Frq: 300		Int: 0	Length: 4s
Station Description: Inactive golf course with occasional freshwater ponds. Pettersson D500x 20' AGL. Recorded by John Chenger, Bat Conservation and Management											
SERVICE	TS	GAIN	TL	START	STOP	BAT	FILES	RUN NIGHT	INVALID TECH	INVALID WEATHER	COMMENTS
05/20/21	3	70	160	2200	607	9	n/a	n/a	n/a	n/a	Deployed
05/30/21	3	70	160	1952	600	6.9	843	9	0	2	Nominal
CLUTTER: NO = stadium-sized open meadow without vegetation or topography interfering with the airspace, LOW = large fields or other open areas bordered by hedgerows or tree lines, EDGE = significant vegetation, topography, or anthropogenic structures bordering a NO or LOW clutter open area, MED = large area with widely spaced trees and other topographic or anthropogenic structures, HIGH = understory travel corridors either along tree-covered roads or within a forested clearing or stream corridor.											



APPENDIX B

Biologist Qualifications

John Chenger

220 Old Stone House Road North
Carlisle, PA 17015

jchenger@batmanagement.com
jchenger@batsurveysolutions.com

Cell: 814-442-4246

-
- **Endangered species biologist and company head with 27+ years of bat sampling and management**
 - **Designer of projects, sampling plans, and specialty equipment to meet clients' permit sampling needs**

*Large Project Mist Net Sampling Plans
PCG WEVCA/USFWS Compliance*

*Indiana Bat Migration Telemetry
Bat Artificial Roost Design*

*Bat Acoustic Survey & Analysis
Bat Survey Training*

Bat Conservation and Management, Inc. — Carlisle, PA

1999 to Present

President/Project Biologist

Created a company based on performing high quality bat sampling and management services for industrial, commercial and government clients. Selected Contributions:

- Design, supervise and run projects to meet USFWS section 7 and 10 Indiana bat consultation needs.
- Supervise up to 20 employees, sampling over 2,000 summer mist net sites and fall & spring mine surveys in 18 states across more than 140 projects.
- Designs bat acoustic monitoring studies in 8 states and provides expert manual analysis of recordings. Expert using SonoBat, Kaleidoscope, Echoclass, BCID analysis software, and Binary Acoustics, Pettersson, and Wildlife Acoustics bat acoustic hardware.
- Supervised employees radio tracking of over 230 bats of 6 species since 2000, including Myso, Myse, Myle, Mylu, Labo, and Laci. Tracking included migration, summer foraging, and locating roosts.
- Supervise employees providing surveys covering most of the needs of developers including mist net surveys, woodrat surveys, bat acoustic surveys, cave and mine project area evaluations, small-footed bat habitat evaluations, and artificial roost design and creation.
- Specialist with macro, near infrared, thermal, and multi-flash photography and video.
- Instructed or co-led over 60 training workshops for federal & state biologists, land managers, and consultants for proper use of acoustic monitoring equipment and bat capture techniques.
- Permitted to sample bats nationwide.

Pennsylvania Game Commission

1992-2006

Biologist Aide

Assisted PGC biologists in a wide variety of biological sampling; Target animals included bats, woodrats, flying squirrels, small mammals, and peregrine falcons. Selected Contributions:

- Performed bat mist net, harp trap, and Anabat surveys; Handled 20,000+ individual bats
- Performed 300+ hibernacula surveys in caves, mines, tunnels, and aqueducts; Skilled in internal and external surveys; Identified 200,000+ individual bats in cave and mine surveys
- Assisted with first identification of modern use at 8 of PA and 2 NJ *M. sodalis* (Indiana bat) hibernacula
- Surveyed potential sites for presence or historic presence of the Allegheny woodrat (*N. magister*)
- Ran small mammal trap lines in remote locations across PA

Select Acoustic-Monitoring Projects

First and foremost is probably the 5 or weeklong workshops and at least one data management workshop each year post processing tens of thousands of files which takes nearly 360 hours per year. The clients would be ~120 of our participants per year. This does not count other private workshops we do for other entities like NPS. Some of this is detailed on Janet's resume, although details stop in 2015, this has continued to present day.

2012 - Capture and Acoustic Field Survey for the US Army Corps of Engineers (Illinois/Missouri), involving site selection for capture and acoustic inventories designed to assess management needs for T&E bats, data collection, and reviewing, vetting and reporting results for over 120 bats captured and 12,000 echolocation call recordings collected.

Client: Benjamin.M.Mcguire@usace.army.mil

2014 - Acoustic Field survey for URS Corporation to assess *Myotis leibii* habitat along a proposed PA Power and Light, ROW near Wilkes-Barre PA: Over 190 bat-detectors, collecting and analyzing over 90,000 recordings from nearly 6,000 hours of monitoring. Client: david.yezuita@aecom.com

2016 - Allegheny Mountain Bat Study near Somerset, PA. Nineteen simultaneous acoustic monitoring stations were maintained continuously for four months collecting over 40,000 files containing bat calls with over 14,000 hours of monitoring. *Myotis*-class files were compared between three different project areas to determine relative activity. Client contact: Tammy Sherwin, Tammy.Sherwin@cdicorp.com

2016 - Acoustic Field Survey for the Natick Soldier Systems Center near Boston, MA. Four (4) acoustic sites were established near locations suggested by the NSSC within the installation for a combined total of 248 monitoring nights, yielding a total of 28,416 confirmed bat passes. Utilizing an acoustic software program with auto classification followed by manual analysis by an expert acoustic bat analyst, a total of six bat species were confirmed. Contact Judi Johnson Judith.L.Johnson@usace.army.mil

2016 - Capture and Acoustic Field Survey for the Sky Island Alliance and USDA Forest Service to survey bat occurrence at man-made wetlands designed for the recovery of the Chiricahua Leopard frog in Rucker Canyon (Chiricahua Mountains) AZ; site selection for capture and acoustic inventories over a 3-site, 5- night period; over 230 acoustic monitoring hours, 20 capture survey hours, over 170 bats captured and 7,700 echolocation call recordings analyzed and manually vetted.

Contact: Carianne Campbell carianne@skyislandalliance.org

2017 - Florida Bonneted Bat Acoustic Surveys, Punta Gorda, FL. 2017. BCM biologists conducted presence/absence acoustic surveys and provided expert call analysis reporting for the endangered Florida bonneted bat in central and southern Florida. 13 detectors recorded for several weeks generating over 20,000 files containing bat calls. Client: Florida Power and Light, contact Brady.Walker@fpl.com

2017 - Florida Bonneted Bat Acoustic Surveys, Punta Gorda, FL. 2017. BCM biologists conducted presence/absence acoustic surveys and provided expert call analysis reporting for the endangered Florida bonneted bat in central and southern Florida. 16 detectors recorded for several weeks generating over 25,000 files containing bat calls. Client: Southwest Engineering and Design, contact Gary Bayne gbayne@sedfl.com

2017 - Florida Bonneted Bat Acoustic Surveys, Westin, FL. 2017. BCM biologists conducted presence/absence acoustic surveys and provided expert call analysis reporting for the endangered Florida bonneted bat in southern Florida. 2 detectors recorded for several weeks generating over 5,000 files containing bat calls. Client: Lotis Engineering Group, contact Miles Walz-Salvador walz-salvador@thelotisgroup.com

2018 - Florida Bonneted Bat Acoustic Surveys, Hialeah, FL. 2018. BCM biologists conducted presence/absence acoustic surveys and provided expert call analysis reporting for the endangered Florida bonneted bat in southern Florida. 3 detectors recorded for several weeks generating over 5,000 files containing bat calls. Client: Kimberly-Horn and Associates, contact Meredith Aiken Meredith.Aiken@kimley-horn.com

2019 - Florida Bonneted Bat Acoustic Data Analysis. Analysis of bat species presence for 8 sites spanning multiple nights consisting of thousands of recordings. Client: ESA, contact Robert Mrykalo RMrykalo@esassoc.com

2018 - Florida Bonneted Bat Acoustic Data Analysis. Analysis of bat species presence for 1600 recordings. Client: South Florida Water Mgmt District, contact Holly Andreotta handreot@sfwmd.gov

2017 - Capture and Acoustic Field Survey for the Sky Island Alliance and Audubon-Whitell Research Ranch to survey bat occurrence at managed wetlands designed for mitigation to aid recovery of the Chiricahua Leopard Frog (Santa Cruz County, Arizona); site selection for capture and acoustic inventories of a 4-site; 7-night period with over 12 capture survey hours and 272 acoustic survey hours, where 12 individual bats of three species were captured and nearly 4,000 individual bat passes were recorded and almost 2,800 were confidently identified to 14 different species. Contact: Carianne Campbell carianne@skyislandalliance.org

2018 - Acoustic Field Survey at the Audubon-Whitell Research Ranch to study the effect of low power acoustic deterrents on bat activity. Four detectors were recording for nearly a month generating thousands of recording manually reviewed to species. Client Electric Power Research Institute, contact Christian Newman cnewman@epri.com

2016 - Acoustic Analysis of nearly 600 full-spectrum echolocation call recordings from 17 passive monitoring deployments and 2 mobile transects for the Environmental Research Group, LLC of Bainbridge GA. The analysis included auto-classification outputs from SonoBat4 (NE) and KaliedoscopePRO with manual vetting of both results to document six common eastern bat species.

2017 - Manual Vetting of nearly 400 full-spectrum echolocation call recordings, representing almost 500 individual bat passes, from select monitoring locations during the years of 2014 thru 2016 for the Canadian Wildlife Service, Northern Conservation Division, Whitehorse YT. Analysis included auto-classification outputs from SonoBat4 (WY) with manual vetting

to confirm the presence of four (4) bat species including three (3) common northwestern Myotis species.
Contact debbie.vandewetering@ec.gc.ca

US Route 219 AMLF Trapping in Pennsylvania, Fall 2017 MYSE/MYLE/PESU

US Route 219 AMLF Trapping in Pennsylvania, Fall 2016 MYSE/MYLE/PESU

US Route 219 AMLF Trapping in Pennsylvania, Fall 2015 MYSE/MYLE/PESU

US Route 219 AMLF Trapping in Pennsylvania, Fall 2014 MYSE/MYLE/PESU

Presented the Acoustic Data Management Course in Wells, Maine at the Wells National Estuarine Research Reserve April 2016, data with MYSE/MYLE/PESU was analyzed

Presented the Acoustic Data Management Course in Duluth, MN at the University of MN-Duluth, Natural Resources Research Institute March 2016, data with MYSE/MYLE/PESU was analyzed

Presented the Acoustic Data Management Course in Harrisburg, PA October 2017, data with MYSE/MYLE/PESU was analyzed

Presented the Acoustic Data Management Course in Harrisburg, PA October 2016, data with MYSE/MYLE/PESU was analyzed

Presented the Acoustic Data Management Course in Harrisburg, PA October 2015, data with MYSE/MYLE/PESU was analyzed

Presented "Bat Detectors and Acoustic Survey Protocols" workshop for the United States Fish and Wildlife Service, in Dixon IA, June 2015, data with MYSE/MYLE/PESU was analyzed

Presented "Bat Survey Protocols: A Field Training Workshop for National Parks Service Staff" in Park City KY, September 2015, data with MYSE/MYLE/PESU was analyzed

I-80 WB Rockfall Mitigation Project, New Jersey 2017

2015 Bat Survey Efforts for U.S. Naval District, Washington, Indian Head Proving Ground, King George County, Maryland, MYSE/MYLE/PESU was analyzed in 2016

2015 Bat Survey Efforts for U.S. Naval District, Washington, Naval Support Facility, Dahlgren Division, Virginia, MYSE/MYLE/PESU was analyzed in 2016

Acoustic Bat Surveys NSF Dahlgren, July 2016, MYSE/MYLE/PESU was analyzed

Acoustic Bat Surveys NSF Annapolis, July 2016, MYSE/MYLE/PESU was analyzed

Acoustic Bat Surveys NSF Carderock, July 2016, MYSE/MYLE/PESU was analyzed

Northern Access National Fuels Acoustic Monitoring Project, NY 2016, 110 sites (220+ nights) analyzed including those with MYSE/MYLE/PESU

Raven Rock Mountain Complex, PA, 2016, data with MYSE/MYLE/PESU was analyzed

PPL Electric Utilities Corporation Northeast-Pocono Reliability Project; Eastern Small-footed Myotis Emergence Survey, 2014, PA, 100+ site data with MYSE/MYLE/PESU was analyzed

2016 Allegheny Tunnel Acoustic Project, PA 2016, 19 sites deployed for multiple months MYSE/MYLE/PESU was analyzed

2017 Seneca Army Depot Energy Project, NY, MYSE/MYLE/PESU was analyzed

Mount Hope Mine Fall Trapping & Acoustic, 2015 MYSE/MYLE/PESU was analyzed

Mount Hope Mine Fall Trapping & Acoustic, 2016 MYSE/MYLE/PESU was analyzed

Rt. 11 Bat Acoustic Survey, CT, 2012 MYSE/MYLE/PESU was analyzed

Custom Training Classes Developed and/or Taught

- 1995-2012 "Bat Conservation and Management" workshops, "Educator" workshops and "Decision Makers" workshops for Bat Conservation International, Inc. (BCI, Austin TX) conducted in Pennsylvania
- 2001-2012 "Acoustic Monitoring for Bats" workshops for BCI at venues in Arizona, California, Kentucky and Pennsylvania.
- 2008-present "Bat Study and Survey Techniques" workshops for Bat Conservation and Management, Inc. (BCM, Carlisle PA) at venues in Arizona, California, Indiana, Kentucky, Maryland, New Jersey, New York, Ontario, Pennsylvania, Tennessee, Texas and West Virginia.
- 2008 "Forest Bat Conservation and Inventory Techniques" workshop for the United States Forest Service, Coronado National Forest in Tucson AZ, 18-19 September.
- 2009 "Acoustic Monitoring as a Non-contact Bat Survey Method" workshop for Cleveland Metroparks in Akron OH, 25 August.
- 2013 "SonoBat Acoustic Analysis Techniques" class for the Pima County Parks Department, in Tucson AZ, 22 April.
- 2013 "Acoustic Survey Field Techniques for Bat Studies" workshop for the United States Fish and Wildlife Service, in State College PA, 20-21 October
- 2014 "Bat Detectors and Acoustic Survey Protocols" workshop for the United States Fish and Wildlife Service, in Dixon IA, 3-5 June.
- 2015 "Acoustic Data Management" training workshops in Alton, IL; Holidaysburg PA; Harrisburg, PA; and Fairfield ME.
- 2015 "Combined Field Survey Techniques" training workshops in Portal AZ; Tulelake CA; and Mammoth Cave, KY.
- 2015 "Field Survey Techniques" training workshop for National Park Service Employees, Mammoth Cave, KY.
- 2016 "Acoustic Data Management" training workshops in Duluth MN, Wells ME, and Harrisburg PA.
- 2016 "Acoustic Survey Methods" training workshop in Punta Gorda FL
- 2016 "Combined Field Survey Techniques for Bats" training workshops in Portal AZ, Tulelake CA, and Mammoth Cave KY.
- 2016 "Field Survey Techniques for Bats" training workshop for California Department of Fish and Game, Tulelake CA.
- 2017 "Acoustic Survey Methods" training workshops in Punta Gorda FL and Tucson AZ
- 2017 "Acoustic Data Management" training workshop in Harrisburg PA
- 2017 "Combined Field Survey Techniques" training workshops in Portal AZ, Tulelake CA, and Mammoth Cave KY.
- 2017 "Field Survey Techniques" training workshop for National Park Service staff in Tulelake CA.
- 2018 "Acoustic Survey Methods" training workshop in Punta Gorda FL
- 2018 "Acoustic Data Management" training workshop in Harrisburg PA
- 2018 "Combined Field Survey Techniques for Bats" training workshop in Portal AZ, Tulelake CA, and Mammoth Cave KY.
- 2019 "Acoustic Data Management" training workshop in Tulsa, OK
- 2019 "Acoustic Survey Methods" training workshop in Tucson, AZ
- 2019 "Cave Management Workshop" training workshop in San Marcos, TX
- 2019 "Experience Texas Bats With Merlin Tuttle's Bat Conservation", Big Bend National Park, TX

Appendix C

Weather Data: Attached Electronic Document

Appendix D

Acoustic Data: Attached Electronic Document