FINAL PERFORMANCE REPORT

Federal Aid Grant No. F16AP00165 (E-22-21)

Management and Cave Protection for Federally-listed Bats and Co-occurring Stygobitic Fauna in Oklahoma

Oklahoma Department of Wildlife Conservation

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Final Performance Report

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A. Abstract:

Human disturbance of maternity caves and hibernacula is a substantial contributor to the historic and present population declines of bats across the United States. Low reproductive rates, long generation times and concentrated populations housed in a relatively small number of caves, make bat populations especially vulnerable to human disturbance and slow to recover from these disturbances. Unique characteristics common to North American subterranean fauna render them vulnerable to anthropogenic activities and underscore the importance of monitoring and protecting sensitive populations. Within the United States, subterranean fauna constitute more than 50% of the G1-G2 species recorded in the Natural Heritage Program; however, less than 4% receive federal protection. Procedures implemented during this project were intended to 1) maintain the bat population in targeted caves by preventing unnecessary human entry and disturbance to critical roosts, and 2) survey stygobitic fauna in Oklahoma and delineate biologically important subterranean systems. Management procedures including gate/grill construction at one cave, and bat population monitoring efforts were completed at 28 different caves. Stygobitic bioinventory surveys were conducted at 5 cave systems and focused on population counts of Ozark Cavefish and both state endemic cave crayfish (*Cambarus* sp.). For the third consecutive year, project personnel participated in continent-wide surveillance for the causative agent for White-nose Syndrome. Individual bats and/or cave substrates tested positive for *Pseudogymnoascus destructans* in 6 caves. Future management recommendations follow the results of these project activities.

B. Need:

The cave-producing karst ecosystem of the Ozark Highlands harbors a diversity of unique and sensitive organisms, many of which are cave obligates. Unique characteristics common to North American subterranean fauna render them vulnerable to anthropogenic activities and underscore the importance of monitoring sensitive populations. Subsurface habitats typically display decreased diversity in community complexity and reduced species abundance relative to above ground ecosystems translating to fewer species and individuals in subterranean habitats than in surface habitats (Holsinger, 1988). Processes that isolate subterranean populations of organisms, and evolutionary adaptation of those species to their environments, can produce extreme patterns of endemism (Barr and Holsinger, 1985; Culver et al, 2000).

Human disturbance at caves is a persistent problem internationally and has been implicated as a cause for decline in several cave-dependent bats (Barbour and Davis, 1969; Humphrey and Kunz, 1976; Tuttle, 1979; American Society of Mammalogists, 1992). About 18 of the 45 species of North American bats rely substantially on caves throughout the year (McCracken, 1989) and all of the North American bats that are listed as endangered or threatened by the United States Fish and Wildlife Service are cave-dependent species or subspecies (McCracken, 1989; Harvey et al., 1999; Pierson, 1999). In the central United States, two obligate cave-dependent species, the Gray Bat (*Myotis grisescens*) and Indiana Bat (*M. sodalis*), and one subspecies, the Ozark Big-eared Bat (*Corynorhinus townsendii ingens*), are of particular concern because each is federally listed as endangered (United States Fish and Wildlife Service 1982, 1983, 1995).

Anthropogenic activities threaten groundwater quality and quantity and consequently the communities of organisms living within groundwater habitats. The combined ranges of over 50% of the described species and subspecies of groundwater-dwelling fauna (stygobites) in the continental United States are estimated to constitute less than 1% of the total surface area of the country (Culver et al, 2000). These phenomena render groundwater species vulnerable to anthropogenic activities and necessitate monitoring of vulnerable species and populations.

Cave gating has been used widely by government and private entities to protect these sensitive ecosystems from direct human impacts. Communities of cave fauna presently are protected with internal gate systems throughout the United States including more than 34 entrances to caves in northeastern Oklahoma (Martin et al. 2006). Seven of those caves have been inhabited historically by colonies of endangered gray bats (Martin et al. 2003). The remaining caves are inhabited by populations of endangered Ozark Big-eared Bats, Big Brown Bats (*Eptesicus fuscus*), Tricolored Bat (*Perimyotis subflavus*), and Northern Long-eared Bats (*Myotis septentrionalis*). Four caves that contain populations of either the Ozark Cavefish [*Troglichthys (Amblyopsis) rosae*], Oklahoma Cave Crayfish (*Cambarus tartarus*) and/or Delaware County Cave Crayfish (*C. subterraneus*) also are protected from human entry by internal gate/grill systems.

The Northern Long-eared Bat was federally-listed as threatened in 2014, and has since been elavated as a species of priority for monitoring under this project. In Oklahoma, Northern Long-eared Bats spend winter hibernating in caves and abandoned mines, and in the summer use caves as maternity and day and night foraging roosts (Caire et al. 1979; Caceres and Barclay 2000). More than 20 caves in Adair, Cherokee, Delaware, and LeFlore counties have been documented to house populations or individuals of Northern Long-eared Bats (Stevenson 1986; Martin and Puckette pers. comm.). White-nose syndrome is currently the predominant threat to the northern long-eared bat, especially throughout the northeast U.S. where the species has declined by up to 99 percent from pre-white-nose syndrome levels at many hibernation sites. Although the disease has not yet spread throughout the northern long-eared bat's entire range it is currently found in at least 22 of 39 states where the northern long-eared bat occurs). Other threats to the species include: wind energy development, habitat destruction or disturbance (e.g., vandalism to hibernacula, roost tree removal), and contaminants.

Procedures during this project were conducted in the Ozark Highlands in northeastern Oklahoma. The Ozarks Highlands cover about 103,000 km^2 in the central United States at elevations of 260–460 m above mean sea level. The Plateau is comprised of alternating layers of limestone, flint (= chert) and sandstone that are conducive to cave formation (Blair and Hubbell 1938). The caves in this region serve as refugia from severe winters and hot summers for many cave-dwelling species (Humphrey and Kunz 1976, Fenolio et al. 2005).

C. Objectives:

1) Protect, maintain, and ultimately recover federally-listed populations of the Ozark Big-eared Bat, Gray Bat, and Northern Long-eared Bat in the Ozark Highlands through the identification of targeted caves by preventing unnecessary human entry and disturbance to critical roosts.
2) Identify critically important cave systems that harbor sensitive stygobitic fauna in the Oklahoma Ozarks and identify biologically important subterranean systems that include but are not limited to historic localities for Amblyopsis rosae and the species of groundwater crayfish that are endemic to Oklahoma.
3) Protect, monitor, and mantain subterranean systems that harbor the federally-threatened Ozark Cavefish, cave crayfish (Cambarus sp.) and other rare and sensitive cave obligate vertebrates and invertebrates in the Ozark Highlands.
4) Monitor the spread and proliferation of the causative fungus for White-nose Syndrome in Ozark caves so that negative impacts to cave-dependent bat populations can be closely monitored, and ultimately, prevented.

D. Results:

Cave Protection and Management—Population estimates of bats at caves prior to installation of gates beginning in 1981 and post-installation estimates show that each cave continues to be used by stable or increasing populations of resident bats (Grigsby et al. 1993, Martin et al. 2000, 2003, 2006; Puckette 2000). Procedures in this project assist in stabilizing sensitive populations of cave fauna in northeastern Oklahoma. The following is a description of caves and management procedures that were conducted during the project.

An important aspect of the long-term E-22 project is monitoring caves that have received past management and protection efforts. These monitoring visits establish continued use by target species, verify the integrity of installed structures intended to eliminate human entry, and are conducted at non-gated caves to determine a ranking hierarchy for need of future consideration of management procedures.

Long-term Management Plan and Gate Installation: Cave AD-7

This cave is located in T15N R24E, Adair County, OK. The site annually serves as a maternity cave for a colony of gray bats. Prior to the initiation of this project it was the only maternity colony of gray bats in the state that not protected from human entry by a gate/grill system. Construction of the internal gate/grill system began in winter 2015-16 and continued through February 2017, and is lacking a single day of work to complete. When finished it

will be the largest internal passage gate/grill system in the state. This has been a collaborative effort between project personnel, and assistance from individuals representing the Nature Conservancy, USFW Service, and the ODWC. The steel grill/gate structure is slated to be completed by December 2017.

Gate and Grill Maintenance

On 14 November 2016 in Delaware County, Oklahoma, five such caves were monitored. At cave **DL-1**, there were no indications of recent human visitation. The grills and gate were intact and the lock was frozen up with debris. The lock was removed and cleaned so that it could function properly. At **DL-3**, the gate, grill and lock were all working properly. There were no indications of human visitation this fall. At **DL-4**, the gate, grills and lock were intact. There were no indications of recent human visitation to the site. At cave **DL 8**, the gate, grill and lock were in good condition. As usual, there had been recent human visitation to the site. At cave **DL-148**, the gate, grill and lock were in good condition and there were no indications of recent human visitation.

White-Nose Syndrome Surveillance

Personnel in this project were invited to participate in three separate monitoring programs that assist in the early detection low levels of infection by the causative fungus *P. destructans* on bat specimens from caves in eastern Oklahoma. Protocols exist for both the cultivation of *P. destructans* and the cultivation-independent detection of this organism based on growth cultivation. Early detection is essential to provide resource managers the time and data necessary to implement a management or containment plan, if necessary.

Through these various sampling efforts researchers have determined that the amount of fungus on bats varies by species and is a predictor of population declines from WNS. The goals of these sampling surveys are to 1) re-sample as many sites as possible that have been previously sampled in the past 4 years to continue our work on understanding how transmission and load dynamics change over time and space; 2) increase sampling in the frontier regions; 3) continue to collect microclimate data to understand the role of variation in temperature and humidity on WNS dynamics; 4) better characterize the environmental reservoir by changing to collecting substrate samples that are not directly underneath a bat; and 5) understand how sociality is related to WNS dynamics (Frick, 2016). In eastern Oklahoma, these goals were implemented through the following surveillance methods:

1) For the fourth consecutive year, pre-white-nose syndrome surveys were conducted in five caves in northeastern Oklahoma in conjunction with the WNS/Pd Continental Transmission Study. Prior to winter 2017, the project sampled over 14,000 bat and substrate samples from 16 species across 259 sites in 34 states and provinces. These samples comprise the largest and most current database for Pd/WNS (Frick 2016). Ten torpid bats from five different caves and surrounding substrates were sampled for the presence of *Pseudogymnoascus destructans* beginning in January 2017 (AD-7; AD-8; DL-21; DL-91: OT-13). Colony cultivation and identification of microfauna was

conducted by the University of New Hampshire's Department of Molecular, Cellular, and Biomedical Sciences (Table 2).

Table 2. Hibernating bats and wall substrates were swabbed in winter 2017 testing the presence of *P. destructans.* DNA was determined by qPCR. These data are considered a preliminary report and the coordinators of the study request that numerical data are not shared beyond the purposes of management and conservation within the ODWC.

Site	Date	Species	Substrate Type	No. Samples	No. Positives
AD-7	1/16/17	PESU		10	9
AD-7	1/16/17	PESU	10cm	5	0
AD-7	1/16/17	PESU	2cm	5	0
AD-8	1/27/17	PESU		10	2
AD-8	1/27/17	PESU	10cm	5	2
AD-8	1/27/17	PESU	2cm	5	3
DL-21	2/10/17	PESU		10	6
DL-21	2/10/17	PESU	10cm	5	2
DL-21	2/10/17	PESU	2cm	5	1
DL-91	1/31/17	PESU		10	0
DL-91	1/31/17	PESU	10cm	5	2
DL-91	1/31/17	PESU	2cm	5	0
OT-13	2/17/17	PESU		10	4
OT-13	2/17/17	PESU	10cm	4	0
OT-13	2/17/17	PESU	2cm	5	1

2) This was the second year that project personnel have collaborated with the Disease Diagnostic Laboratories of the USGS National Wildlife Health Center in Madison, WI, to collect swab samples for white-nose syndrome surveillance. Combined wing/muzzle swabs from 23 Tri-colored bats and two Ozark Big-eared Bats were collected on 25 March 2017 at cave AD-221 in Adair County. Visible fungus infection was noted in a single Tri-colored bat at the time of the survey. The two Ozark Big-eared bats were negative, but 19/23 Tri-colored bats tested positive for Pd.

Bioinventories

Bat Monitoring

Monitoring at hibernacula was conducted from December 2016 through March 2017. Summer roost monitoring was conducted from May through September 2016 at selected caves to determine use patterns and if possible, population estimates (Table 1).

Table 1. Results of population estimates and species richness monitored at select caves in eastern Oklahoma during 2016-17.

Date	County	Cave Number	Gated	Monitoring Results
27-May-16	Adair	AD-13	Yes	71 COTO (Emergence)
8-Jun-16	Adair	AD-10	Yes	258 COTO (Emergence)
13-Jun-16	Adair	AD-17	Yes	89 COTO (Emergence)
13-Jun-16	Adair	AD-18	Yes	49 COTO (Emergence)
22-Jul-16	Delaware	DL-91	Yes	16,520 MYGR (Emergence)
22-Jul-16	Delaware	DL-2	No	0 (Emergence)
9-Sep-16	Delaware	DL-2	No	0 (Emergence)
9-Sep-16	Delaware	DL-91	Yes	13,340 MYGR (Emergence)
25-Nov-16	Adair	AD-8	Yes	189 PESU
27-Dec-16	Adair	AD-13	Yes	8 PESU
27-Dec-16	Adair	AD-15	Yes	78 PESU; 9 MYSE; 3 COTO
27-Dec-16	Adair	AD-21	Yes	0
2-Jan-17	Adair	AD-17	Yes	107 PESU
2-Jan-17	Adair	AD-18	Yes	98 PESU; 1 EPFU
16-Jan-17	Adair	AD-7	No	146 PESU
18-Jan-17	Sequoyah	SQ-1	No	236 PESU; 2 MYSE
27-Jan-17	Adair	AD-8	Yes	191 PESU
31-Jan-17	Delaware	DL-91	Yes	21 PESU
8-Feb-17	Adair	AD-111	No	7 PESU
8-Feb-17	Adair	AD-92	No	1 PESU
8-Feb-17	Adair	ADT-23b	No	4 COTO
10-Feb-17	Delaware	DL-21	No	38 PESU
10-Feb-17	Adair	ADT-1	No	2 PESU; 19 COTO
17-Feb-17	Ottawa	OT-13	Yes	18 PESU
28-Feb-17	Adair	AD-50	No	2 PESU
28-Feb-17	Adair	AD-51/52	No	5 PESU
25-Mar-17	Adair	AD-29	Yes	3 PESU; 1 COTO
25-Mar-17	Adair	AD-30	Yes	24 PESU; 2 COTO
25-Mar-17	Adair	AD-54	Yes	48 PESU; 2 COTO
25-Mar-17	Adair	AD-211	Yes	7 PESU
25-Mar-17	Adair	AD-221	Yes	83 PESU; 7 COTO

MYGR: *Myotis grisescens*
MYSE: *Myotis septentrionalis*
EPFU: *Eptesicus fuscus*
COTO: *Corynorhinus townsendii ingens*
PESU: *Perimyotis subflavus*

Stygobitic Fauna

Since 2001, Dr. Danté Fenolio from the San Antonio Zoo has been assisting the Ozark Plateau National Wildlife Refuge and Oklahoma Ecological Services Field Office with subterranean surveys and bioinventory work in the Ozark Highlands.1. In particular, regular censuses of subterranean habitats containing populations of Ozark Cavefish and both state endemic cave crayfish, (*Cambarus* sp.) have been a focus of these surveys. Extensive surveys of these systems have since revealed that the state-endangered *C. tartarus* occurs in at least two different caves within the Spavinaw Creek watershed (Graening et al. 2006). Examining caves where historical records of Ozark Cavefish exist but where they have not been observed in recent years is also a central goal. Trapping in caves with historical reports of cave crayfish and where the identification of those populations has not been determined has also been a focus. Of note during these surveys are other important subterranean species such as the Grotto Salamander (*Eurycea spelaea),* groundwater amphipods, (*Stygobromus* spp.), and range-limited groundwater isopods, such as Mackin's Cave Isopod (*Caecidotea mackini).* Data collected from these surveys have been provided to the Subterranean Biodiversity Project database, originally maintained by Dr. G.O. Graening and now by Michael E. Slay of The Nature Conservancy in Fayetteville, Arkansas. A formal final report of the first 13 years of the project has been published through the University of Oklahoma Press, "*Cave Life of Oklahoma and Arkansas*" by Graening, Fenolio, and Slay. Species descriptions, conservation updates, and biological observations are being published every year.

The 2017 Ozark aquatic cave life surveys were planned for March 2017. For the four days of surveys that were performed, subterranean biologists Drs. Matthew L. Niemiller (Illinois Natural History Survey), Michael E. Slay (The Nature Conservancy) and Evin T. Carter (University of Tennessee), participated in bioinventories. USFWS biologists Richard Stark and Daniel Jackson participated in two days of bioinventory work. Each day of this trip, only one cave, or cluster of caves in close proximity, were surveyed. Owing to the threat of transferring the fungus *Pseudogymnoascus destructans*, all gear was washed with appropriate disinfectants and decontaminated prior to use the following day in a new system. The USFWS-approved WNS decontamination protocol was followed.

Cave AD-8: 21 March 2017

Surveyors: Danté Fenolio, Matthew L. Niemiller, and Evin T. Carter

Cave AD-8 is a gated and locked cave system. It serves as a significant Gray Bat (*Myotis grisescens*) maternity site in summer and has substantial guano deposits ca. 250 meters into the system. The entrance is a low and tight crawlway and the gate lock can be difficult to unlock and open. A stream issues through the cave, exiting the natural entrance. The stream harbors significant guano deposits. This cave is home to an endemic groundwater isopod, *Caecidotea macropropoda* (Fig. 1). The cave system is biologically diverse and accommodates Grotto Salamanders (*Eurycea spelaea*), Tri-Colored Bats (*Perimyotis subflavus*), and groundwater flatworms (*Dendrocoelopsis*

americana). The lock on the cave gate was in good working order this visit and we gave it a shot of WD40 for good measure.

Figure 1: An endemic groundwater isopod, *Caecidotea macropropoda*, in Cave AD-8, Delaware Co., OK. Image by Danté Fenolio.

Faunal Inventory: Cave AD-8

- 800+ Gray Bats, *Myotis grisescens*
- 226 Tri-Colored Bats, *Perimyotis subflavus*
- 36 dead Tri-Colored Bats, *Perimyotis subflavus*
- 5 Pickerel Frogs, *Lithobates palustris*
- 4 Green Frogs, *Lithobates clamitans*
- 6 Cave Salamanders, *Eurycea lucifuga*
- 2 Dark Sided Salamanders, *Eurycea longicauda melanopleura*
- 10 Grotto Salamanders (larvae), *Eurycea spelaea*
- 50+ Mixed *Eurycea* larvae (*Eurycea l. melanopleura* & *E. lucifuga*)
- 6 dead *Eurycea* larvae
- 5 Slimy Salamanders, *Plethodon albagula*
- 4 Heleomyzid Flies, Family heleomyzidae
- 200+ Cave Dung Flies, *Spelobia* sp.
- 10+ Cave Fungus Gnats, Family Mycetophilidae
- 10+ Pseudoscorpions, *Hesperochernes occidentalis*
- 20+ Moths
- 10+ Scaffold Web Spiders, *Eidmanella* sp.
- 3 Fishing Spiders *Dolomedes* sp. (at the cave mouth)
- 4 Meshweaver Spiders, *Cicurina* sp.
- 50+ Cave Crickets, *Ceuthophilus* cf *gracilipes*

- 500+ Groundwater Isopods, *Caecidotea macropopoda*
- 1 Raccoon scat, *Procyon lotor*
- 3 Cave Beetles, *Platynus* sp.
- 2 Rove Beetles, Family Staphylinidae
- 2 Beetle Larvae
- 50+ Mosquitoes, Culicidae

Caves DL-48/49: 22 March 2017

Surveyors: Danté Fenolio, Matthew L. Niemiller, Michael E. Slay, Richard Stark, Daniel Jackson and Evin T. Carter

The Mitchell Cave system is a series of smaller caves on the bank of Spavinaw Creek and within a mile of the Ozark Plateau National Wildlife Refuge headquarters (Looney Unit). The caves sit on a piece of property that is privately owned. Prior to this visit, requests to survey the caves had been denied by the previous landowner. The property has recently changed hands and the new landowner is receptive to biological inventory of the caves. These caves serve as biologically significant systems because of records of both Ozark Cavefish [*Troglichthys (Amblyopsis) rosae*] and an unidentified cave crayfish species, *Cambarus* sp. The cave crayfish, owing to proximity with the January-Stansbury Cave system, is most likely the Oklahoma Cave Crayfish, *C. tartarus*.

On this visit and while walking to the mouth of the first of these caves, we observed a family of otters (*Lontra canadensis)*. The adult pair had with them three small young. Otter scat was observed in all three systems and clear pathways through the vegetation from the cave mouths to the edge of the river could be seen at two of the three cave mouths. Also, a human skull was found just inside the entrance of Mitchell Cave No1 that had the skull cap removed - apparently using some kind of blade (such as a hack-saw). The skull looked old and worn. The authorities were contacted and R. Stark contacted the landowner. An investigation was opened by local authorities to ensure that the skull was either an artifact from earlier Native American inhabitance of the region or a medical school piece that had been removed from a laboratory.

Figure 2: A Cave Salamander, *Eurycea lucifuga*, observed in Cave DL-48(1), Delaware Co., OK. Image by Danté Fenolio.

Figure 3: An uncommonly encountered form of Cave Salamander, *Eurycea lucifuga*, is "piebald" – which is a blotched pattern that lacks pigment in places and originates from a genetic aberration. Observed in Cave DL-48(2), Delaware Co., OK. Image by Danté Fenolio.

Faunal Inventory, Cave DL-48(1)

- 8 Dark Sided Salamanders, *Eurycea melanopleura longicauda*
- 2 Cave Salamanders, *E. lucifuga* (Fig. 2)
- 2 Western Slimy Salamanders, *Plethodon albagula*
- 1 Pickerel Frog, *Lithobates palustris*

- 1 Raccoon scat, *Procyon lotor* (best guess at deciphering from Raccoon scat)
- 20+ Otter scat, *Lontra canadensis* (best guess at deciphering from otter scat)
- 3 Tri-Colored Bats, *Perimyotis subflavus*
- >20 Hothouse Millipede, *Oxidus gracilis*
- 1 millipede (unknown taxonomy)
- 1 slug (unknown taxonomy)
- 1 Meshweaver Spiders, *Cicurina* sp.
- 5 Scaffold web spiders, *Eidmanella* sp.
- 1 Fishing Spider, *Dolomedes tenebrosus*
- >20 Cave Dung Flies, *Spelobia* sp.
- 30+ Common Cave Cricket, *Ceuthophilus* cf *gracilipes*
- 1 Cave Cricket, *Ceuthophilus* sp.
- 2 Heleomyzid Flies, Family Heleomyzidae

Faunal Inventory, Cave DL-48(2)

- 8 Dark Sided Salamanders, *Eurycea melanopleura longicauda*
- 2 Cave Salamanders, *E. lucifuga* (1 individual was piebald) (Fig.3)
- 2 Western Slimy Salamanders, *Plethodon albagula*
- 10+ Raccoon scat, *Procyon lotor* (best guess at deciphering from Raccoon scat)
- 20+ Otter scat, *Lontra canadensis* (best guess at deciphering from otter scat)
- 5 Tri-colored Bats, *Perimyotis subflavus*
- 1 Eastern Phoebe, *Sayornis phoebe* (old nest)
- 4 Earthworms, annelids
- 2 "Invasive Roly Polly," Terrestrial isopod
- 1 Millipede, *Abacion* sp.
- 1 Cave Millipede, *Trigentyla hoscki*
- 12 Meshweaver Spiders, *Cicurina* sp.
- 5 Scaffold Web Spiders, *Eidmanella* sp.
- 1 Fishing Spider, *Dolomedes tenebrosus*
- 100+ Common Cave Cricket, *Ceuthophilus* cf *gracilipes*
- >20 Cave Dung Flies, *Spelobia* sp.
- 5 Heleomyzid Flies, Family Heleomyzidae
- 1 Cantherid beetle, Family Cantharidae

Faunal Inventory, Cave DL-49

- 4 Cave Salamanders, *E. lucifuga*
- 17 *Eurycea* larvae (aquatic)
- 20+ Western Slimy Salamanders, *Plethodon albagula*
- 1 Pickerel Frog, *Lithobates palustris*
- 1 Eastern Phoebe, *Sayornis phoebe* (old nest)
- 9 Tri-Colored Bats, *Perimyotis subflavus*
- 10+ Raccoon scat, *Procyon lotor* (best guess at deciphering from Raccoon scat)

- 10+ Otter scat, *Lontra canadensis* (best guess at deciphering from otter scat)
- 2 Earthworms, annelids
- 1 Groundwater isopod, *Caecidotea* sp.
- 1 Ringed Crayfish, *Orconectes neglectus*
- 200+ Hothouse Millipede, *Oxidus gracilis*
- 1 Terrestrial Isopod, *Armadillium* sp.
- 1 psocopteran, Order Psocoptera (booklice)
- 1 Meshweaver Spiders, *Cicurina* sp.
- 3 Scaffold Web Spiders, *Eidmanella* sp.
- 4 Globular Springtail, *Pygmarrophalites* sp. (collected from the surface of a pool of water)(Fig.4)
- 25+ Common Cave Cricket, *Ceuthophilus* cf *gracilipes* (Fig.5)
- 50+ Cave Dung Flies, *Spelobia* sp.
- 2 Heleomyzid Flies, Family Heleomyzidae

Figure 4: A globular springtail, *Pygmarrophalites* sp., collected from the surface of a cave pool in Cave DL-49, Delaware Co., OK.

Figure 5: A Common Cave Cricket, *Ceuthophilus* cf *gracilipes*, observed in Cave DL-49, Delaware Co., OK.

DL-39: 23 March 2017

Surveyors: Danté Fenolio, Matthew L. Niemiller, Michael E. Slay, Richard Stark, Daniel Jackson and Evin T. Carter

We performed the annual count of Oklahoma Cave Crayfish, *Cambarus tartarus* (Fig.6). This is the longest survey in the regular survey work we perform. In the past, the survey has taken as long as 9 hours. This trip took 6 hours. We began the survey from the Stansbury Entrance. The section of the cave from the Moonshine Room to the January-Stansbury entrance is not the habitat where we typically encounter *C. tartarus*; however, this year we started from the main entrance and surveyed everything. The lower section of cave stream hosts abundant surface crayfish (*Orconectes neglectus*) which undoubtedly compete with, and may prey on, the cave crayfish. The 2017 count of *C. tartarus* (23) was a slight increase from the 2016 count (19), In addition, the 2016 total was a 42% decrease from the 2014 count of 45 individuals. Lower counts across the last two surveys may be a result from serious floods / scouring events of the cave system that took place in late 2015 and early 2016. We collected morphometric data for 19 cave crayfish (all that we could capture). The Tri-Colored Bat (*Perimyotis subflavus*) count has increased significantly since 2014, from 27 (winter count) in 2014 to 227 (winter count) in 2016, and then to 1,310 in spring 2017. Importantly, this latest count (2017) included a count from the Stansbury entrance near the cabin; the earlier two counts were from the January entrance (Moonshine Room) and above. About 10 dead bats were observed (believed to be *P. subflavus*). Gray Bats (*Myotis grisescens)* were also observed in several small clusters.

Figure 6: An Oklahoma Cave Crayfish, *Cambarus tartarus*, observed during this year's annual survey of Cave DL-39 Delaware Co., OK

Faunal Inventory: Cave DL-39

- 12 Cave Salamanders, *E. lucifuga*
- 2 Dark Sided Salamanders, *Eurycea melanopleura longicauda*
- 14 *Eurycea* larvae (aquatic)
- 13 Grotto Salamander larvae, *E. spelaea* (aquatic)
- 5 Western Slimy Salamanders, *Plethodon albagula*
- 21 Pickerel Frog, *Lithobates palustris*
- 1,310 Tri-Colored Bats, *Perimyotis subflavus* (one with wing band, "Libby B226" on right forearm); Per R. Stark, the bat was banded by Gary Libby in 2013, who set up a small net in the front of Jan-Stan during the 2013 bat blitz.)(Fig.7)
- ~10 Dead Tri-colored Bats, *Perimyotis subflavus* – (1 body was collected by R. Stark for WNS testing. The tests confirmed that the bat was *Pd*+ positive, but the body was too decomposed for histology to confirm WNS).
- 53 Gray Bats, *Myotis grisescens* (plus a cluster ~1.5ft x 1.5ft - this may be close to 300-400 bats based on Harvey's mean clustering density of 1828 GBs per square meter)(Fig.8)
- 2 Northern Long-eared Bats, (*Myotis septentrionalis*)

- 2 Groundwater Amphipods, *Stygobromus* sp.
- 3 Groundwater Isopods, *Ceaecidotea* sp.
- 23 Oklahoma Cave Crayfish, *Cambarus tartarus*
- 21 Ringed Crayfish, *Orconectes neglectus*
- 2 Scaffold Web Spiders, *Eidmanella* sp.
- 10 Common Cave Cricket, *Ceuthophilus* cf *gracilipes*
- 12 Cave Dung Flies, *Spelobia* sp.
- 3 Cave Millipedes, *Trigentyla blacki*
- 3 Ground Beetles, *Platynus* sp., Family Carabidae
- 50+ Heleomyzid Flies, Family Heleomyzidae

Figure 7: A banded Tri-Colored Bat, *Perimyotis subflavus*, observed in January-Stansbury Cave during the annual cave crayfish count.

Figure 8: A cluster of Gray Bats, *Myotis grisescens*, observed in January-Stansbury Cave during the annual cave crayfish count.

Cave DL-33: 24 March 2017

Surveyors: Danté Fenolio, Michael E. Slay, Bill Puckette

Cave DL-33 is owned by a private landowner. It has a low entrance that is elevated by roughly two or three meters above the stream that cuts through the floor of the hollow containing the site. The entrance is a low walk and crawl but opens to walking passage. There were several isolated pools at the mouth of the cave when we visited it. A stream issues through the system with numerous slow flowing pools. There are a couple of tight squeezes in the system when following the waterway. Approximately 300 meters into the cave system, the passage turns into a low crawl in the water.

Figure 9: A Fishing Spider, *Dolomedes tenebrosus*, observed in both Cave DL-48/49 Systems and Cave DL-33, Delaware Co., OK.

Faunal Inventory: Cave DL-33

- 10 Grotto Salamander larvae, *Eurycea spelaea*
- 1 Western Slimy Salamander, *Plethodon albagula*
- 1 Pickerel Frogs, *Lithobates palustris*
- 13 Tri-Colored Bats, *Perimyotis subflavus*
- 1 Raccoon scat, *Procyon lotor*
- 1 Aquatic worm in mucous membrane
- 1 aquatic subterranean flatworm, *Dendrocoelopsis americana*
- 12 Groundwater amphipods, *Stygobromus* sp.
- 10+ *Caecidotea* sp., subterranean aquatic isopods (small, ~2-4mm)
- 1 Hothouse Millipede, *Oxidus gracilis*
- 1 Millipede, Polydesmida
- 10+ Mosquitoes, Family Culicidae
- 10+ Heleomyzid Flies, Family Heleomyzidae
- 10+ Cave Dung Flies, *Spelobia* sp.
- 10+ Cave Crickets, *Ceuthophilus* cf *gracilipes*
- 1 Fishing Spider, *Dolomedes tenebrosus* (Fig.9)
- 1 Scaffold Web Spider, *Eidmanella* sp.

Figure 10: A Midland Watersnake, *Nerodia sipedon pleuralis*, in Brush Creek (immediately outside of the mouth of Cave DL-33) at 3 meters depth and on the bottom of the creek (under water), Delaware Co, OK, March 2017.

E. Discussion and Recommendations:

1. Cave AD-7 in Adair County is the last known maternity colony of Gray Bats in Oklahoma that is currently unprotected from human entry and disturbance. Verifying landownership of the cave's two entrances and successfully securing access across private properties was a crucial step in providing long-term protection to the critical bat roosts inside the cave. Construction of the gate/grill system was initiated in a previous grant segment (November 2015) and will continue to completion for the next grant (winter 2017). Beginning in winter 2017-18 a side passage and second entrance to the cave is targeted for a gate/grill system so that the cave interior and sensitive fauna will be protected from human entry and disturbance.

2. Annual monitoring of caves that have received past management and protection efforts will continue. These visits establish continued use by target species, verify the integrity of installed structures intended to eliminate human entry, and are conducted at non-gated caves to determine a ranking hierarchy for need of future consideration of management procedures.

3. Biological inventories of caves continues to identify biologically important sites for future conservation efforts and add to the overall knowledge of the status and distribution of Ozark cave fauna.

4. Considerable emphasis by multiple government agencies is being placed on pre-WNS management and monitoring in states where the vector is likely to be (or has recently been) detected. Oklahoma is considered one of those states. Monitoring torpid populations and surrounding substrate will continue to be an appropriate extension of this project. Construction of gate/grill systems in cave passages effectively removes the threat of human transmission between caves in pre-WNS areas.

5. Identifying caves that are inhabited by populations of *M. Septentrionalis*, management efforts to protect the cave-dwelling populations of the species from human activity, and containment of potential transmission of WNS is now an important and significant aspect of this project.

F. Significant Deviations:

There were no significant deviations from the stated objectives.

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