

FINAL PERFORMANCE REPORT



Federal Aid Grant No. F18AP00194 (E-22-23)

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

Oklahoma Department of Wildlife Conservation

Grant Period: January 1, 2019 – December 31, 2019

Report Period: January 1, 2019 – December 31, 2019

Final Report

State: Oklahoma

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Grant Program: Endangered Species Act Traditional Section 6

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I. 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 are 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 delineating biologically important subterranean systems. Management procedures including gate/grill construction and repair at two caves, and population monitoring efforts were completed at 37 different caves. Stygobitic bioinventory surveys were conducted at 6 cave systems and focused on population counts of Ozark Cavefish and both state endemic cave crayfish.

II. BACKGROUND:

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 (*Myotis 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.

Widely used by government and private entities to protect these sensitive ecosystems from direct human impacts, cave gates and their designs have evolved over the past 50 years. Original gate designs negatively impacted bat ingress and egress, behavior and energetics (Spanjer and Fenton 2005; Derousseau and Huntly 2012; Diamond and Diamond 2014), and cave microclimates (Richter et al. 1993). Post-gate monitoring responses by bats and cave microclimates using more compatible gate designs, especially those installed in “dark zones” (locations inside the cave passage), indicate positive or neutral effects on populations (Martin et al. 2003; Crimmins et al. 2014) and microclimates (Martin et al., 2006). Other studies indicate species exhibiting poor maneuverability (Norberg and Rayner 1987) and narrow call bandwidths (Tobin and Chambers 2017) are negatively impacted by cave gates. However, most bats acclimate to appropriately-placed cave and mine gate installations (Martin et al. 2003; Slade and Law 2008; Tobin et al. 2018). Ultimately, for many species, bat activity is influenced more by entrance characteristics (size, number, shape) than by cave or mine gates (Johnson et al., 2006; Tobin et al., 2018)

Communities of cave fauna presently are protected with internal gate systems at 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 (*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.

Procedures during this project were conducted in the Ozark Highlands in northeastern Oklahoma. The Ozarks Highlands cover about 103,000 km² (Huffman 1959) 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).

III. OBJECTIVES:

The objectives of this project assist in the recovery of the Gray Bat, Ozark Big-eared Bat, Northern Long-eared Bat, Ozark Cavefish and two endemic cave crayfishes (*Cambarus* sp.) that are species of concern, by working with cave owners and constructing internal gate and grill systems within those caves that support populations of one or more of these species. The internal gate/grill systems prevent unauthorized human entry into those caves and protect bats and cavefish from human disturbance which is especially important for bat populations during hibernation and pup rearing. This project also supports biological inventories of Ozark caves to identify and prioritize caves based upon their importance to the three federally listed species and other Ozark cave-endemic species that are similarly affected by human disturbance within their cave environments. These biological data improve the effectiveness of the overall cave gating project by ensuring the resources are directed to the most important caves. These data also assist in the monitoring and status assessment of cave-dependent species so that future management decisions can be based on better information. The primary objectives of this project are:

- 1) Maintain the bat population in targeted caves by preventing unnecessary human entry and disturbance to critical roosts.
- 2) Survey the stygobitic fauna in Oklahoma and delineating biologically important subterranean systems to include historic localities for *Amblyopsis rosae* and the species of groundwater crayfish endemic to Oklahoma.
- 3) Participate in baseline survey techniques that will monitor the impact of the causative agent of White-nose Syndrome on targeted cave-dwelling bat species.
- 4) Initiate presence surveys of caves that have been historically identified as potential roosting habitat for the threatened Northern Long-eared Bat (*Myotis septentrionalis*) and, if documented, develop and prioritize plans for management and colony protection measures.

IV. PROCEDURES:

Cave 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.

Cave AD-7

This cave is located in T15N R24E, Adair County, OK. Historically the site served 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 not protected from human entry by a gate/grill system. Preceding the grant segment, construction of the internal gate/grill system at the primary entrance began in winter 2015-16 and continued through 2018. This has been a collaborative effort between project personnel, and assistance from individuals representing the Nature Conservancy, U.S. Fish and Wildlife Service, and the ODWC. That same year, initial structures were installed to restrict a second passage to the cave. Project personnel implemented grill design alterations following previous abandonment by the gray bat colony in 2018.

During this grant segment, a grill system was completed in an alternative, secondary passage and entrance on 28 March 2019 and the final bar and hub mechanism was installed on the initial grill system on 21 November 2019. This moveable bar allows access into and out of the cave for researchers.

Cave CZ-9

The cave historically houses a maternity colony of gray bats. The entrance is located in Flowers Creek below a reservoir (Ft. Gibson) and a location that experienced significant flooding in late May 2019. A trapping and exit survey was conducted on 17 July 2019 to observe effects of flooding in Flowers Creek. Water levels in excess of 10'-12' occurred roughly 0.5 mile upstream (east) and no doubt inundated the alluvial riparian floor of the valley. The cave entrance to CZ-9 is located above a secondary tributary stream 0.5 mile from the confluence into Flowers Creek from the south. Evidence did not suggest this riparian region was inundated by flood waters from Grand River or Flowers Creek. However, evidence indicates this secondary tributary also experienced extreme levels of flow and flooding reaching to within 10' of the cave's entrance. No doubt excessive flow from the cave itself resulted from record rain events in the maternity season in mid to late May 2019. There was no substantive evidence that the colony of gray bats inhabited the cave in 2019. Some guano trailed in the main passage from the grill system to the entrance, but not indicative of a typical colony that historically uses the cave. The gate/grill system was inspected and determined to have been vandalized. The locking hasp mechanism has been severed allowing the door to be opened freely and human entry into the cave passage unhindered. A harp trap was set at the entrance where 15 PESU males, 6 MYGR Males (1 adult; 4 young of year), and 4 MYGR Females (1 adult post lactating; 1 adult non-lactating; 2 yoy) were captured.

Cave AD-220

The site is a limited gray bat roost site and past surveys have encountered northern long-eared bats. No bats were captured during an exit survey using a harp trap at the entrance to the cave on 5 June 2019. However, guano accumulation at two roost locations in the cave passage indicate recent gray bat use (about 500 bats) was noted. Upon inspection of the internal gate/grill system it was noted it had been vandalized. The system was originally equipped with a removable bar intended to allow access to researchers. The bar and lock mechanisms were removed allowing

unhindered human access into the cave passage. The bar was retrieved, repaired and reinstalled during a return visit on 18 December 2019. However, the mechanism is still in need of some minor repair.

Cave Monitoring—an important aspect of the long-term E-22 project is monitoring caves that have received past management and protection efforts. Periodic monitoring visits at caves and cave entrances are used to document continued use by target species, verify the integrity of installed structures intended to eliminate human entry, determine use patterns, conduct population estimates, for White Nose Syndrome (WNS) evaluations and are conducted at non-gated caves to determine a ranking hierarchy for need of future consideration of management procedures. Population monitoring is typically conducted by guano measurements while the site is vacated, utilizing infra-red illumination and night vision optics to passively view colony emergences, or visual inspections at hibernacula. A total of 38 such visits were made in 2019 (Table 1). Monitoring at hibernacula was conducted from January through March 2019. Summer roost monitoring was conducted from May through September 2019 at selected caves to determine use patterns and if possible, population estimates (Table 1).

V. RESULTS AND DISCUSSION:

Table 1. Results of population estimates and species richness monitored at select caves in eastern Oklahoma during 2019. MYGR: *Myotis grisescens*, COTO: *Corynorhinus townsendii ingens*, MYSE: *Myotis septentrionalis*, PESU: *Perimyotis subflavus*, EPFU: *Eptesicus fuscus*.

Date	County	Cave	Monitoring Results
4-Jan-19	Adair	AD-29	7 PESU
4-Jan-19	Adair	AD-30	22 PESU
4-Jan-19	Adair	AD-54	24 PESU
4-Jan-19	Adair	AD-211	2 PESU
4-Jan-19	Adair	AD-221	21 PESU; 6 COTO
23-Jan-19	Delaware	DL-21	29 PESU
26-Jan-19	Adair	ADT-1	1 EPFU; 1 PESU; 16 COTO
29-Jan-19	Adair	AD-14 Sawney	8 COTO
29-Jan-19	Adair	AD-14 Back Door	2 MYGR; 3 PESU
5-Feb-19	Adair	AD-125	3 PESU; 78 COTO
5-Feb-19	Adair	AD-14 Sawney	1 EPFU; 1 MYGR; 1 PESU; 2 COTO
11-Feb-19	Delaware	DL-1	2 MYGR; 26 PESU
20-Feb-19	Adair	AD-10	4 COTO; 7 PESU
28-Feb-19	Adair	AD-15	1 EPFU; 4 COTO; 98 PESU
28-Feb-19	Adair	AD-21	14 PESU; 2 COTO
9-May-19	Adair	AD-126	No usage
9-May-19	Adair	AD-127	No usage
9-May-19	Adair	AD-129	No usage
21-May-19	Delaware	DL-91	15,200 MYGR (Exit survey)
30-May-19	Adair	AD-120	No usage

30-May-19	Adair	AD-121	No usage
30-May-19	Adair	AD-122	No usage
30-May-19	Adair	AD-123	No usage
30-May-19	Adair	AD-124	No usage
31-May-19	Adair	AD-13	50 COTO (Emergence count)
4-Jun-19	Adair	AD-125	110 COTO (Emergence count)
8-Jun-19	Adair	AD-52	No usage
10-Jun-19	Adair	AD-17	No usage
10-Jun-19	Adair	AD-18	No usage
10-Jun-19	Adair	AD-125	78 COTO (Emergence count)
12-Jun-19	Adair	AD-10	185 COTO (Emergence count)
25-Jun-19	Adair	AD-7	10,000 MYGR (Emergence count)
25-Jul-19	Adair	ADT-1	1 COTO
25-Jul-19	Delaware	DL-91	5,425 MYGR (Emergence count)
30-Jul-19	Delaware	DL-2	No usage
2-Dec-19	Delaware	DL-21	No usage
4-Dec-19	Delaware	DL-91	9,000 MYGR (Guano)
18-Dec-19	Adair	AD-220	500 MYGR (Guano); 62 PESU

VI. 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. Construction of the gate/grill system needs to continue to completion in future grant segments.
2. Cave CZ-9 in Cherokee County houses a maternity colony of gray bats currently unprotected from human entry and disturbance because of vandalism to the existing system. Repair of the gate/grill system is of considerable importance.
3. Cave AD-220 in Adair County serves as a night roost for gray bats, northern long-eared bats, and hibernating population of tri-colored bats. Partial repairs to the gate/grill system have been made, but full repair of the gate/grill system is needed.
4. Annual monitoring of caves that have received past management and protection efforts should 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.
5. 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.

6. Considerable emphasis by multiple government agencies is being placed on WNS management and monitoring in states where the vector has been detected. Monitoring torpid populations should continue in the future. Construction of gate/grill systems in cave passages effectively removes the threat of human transmission between caves in pre-WNS areas.
- 7 Due to the ongoing decline of northern long-eared bats (*Myotis septentrionalis*) from White-nose Syndrome, we recommend continuing to identify and monitor caves in the Ozark Highlands that are inhabited by populations of the species.

VII. SIGNIFICANT DEVIATIONS:

There were no significant deviations from the stated objectives.

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Date: February 14, 2020

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