

# **FINAL PERFORMANCE REPORT**



**Federal Aid Grant No. F13AP00088 (E-22-18)**

**Management and Protection for the Ozark Big-Eared Bat, Gray Bat, and  
Stygobitic Fauna in Oklahoma**

**Oklahoma Department of Wildlife Conservation**

**December 1, 2012 through March 31, 2014**

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**State:** Oklahoma

**Project Number:** E-22-18 (F13AP00088)

**Grant Program:** Endangered Species Act Traditional Section 6

**Grant Period:** 1 December 2012 – 31 March 2014

**Project Title:** Management and Protection for the Ozark Big-eared Bat, Gray Bat, and Stygobitic Fauna in Oklahoma

## A. Abstract:

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. 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 and/or repair, and passage enhancement, were conducted at three caves, and population monitoring efforts were completed at 24 caves that have received past management and protection efforts. Stygobitic surveys were conducted at 3 caves and focused on population counts of Ozark Cavefish and both state endemic cave crayfish. 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 (*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.

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 (*Amblyopsis rosae*), Oklahoma cave crayfish (*Cambarus tartarus*) and/or Delaware County cave crayfish (*Cambarus 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 Ozark Highlands cover about 103,000 km<sup>2</sup> (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).

### **C. Objectives:**

- 1) Maintain the bat population in targeted caves by preventing unnecessary human entry and disturbance to critical roosts
- 2) Survey the 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.

## **D. Results:**

***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 cave fauna in northeastern Oklahoma. The following is a description of caves and management procedures that were conducted during the project.

### **Passage Manipulation and Enhancement: Cave DL-2**

Cave DL-2 is located in Section 17 of T23N R23E in Delaware County, OK adjacent to Drowning Creek, a tributary of Grand Lake. The cave passage is <65m long with a single historical roost site for gray bats located 4m above a persistent stream and about 5m inside the entrance to the cave. The floor of the vertical entrance to the cave is <745 ft elevation with backflow into the cave from Grand Lake at 746 ft elevation. Complete inundation of the cave passage is at 752 ft elevation. The roost was first documented as housing a colony of gray bats in 1981 when the colony was estimated to be 13,700 bats. Based on recent exit and capture surveys at the entrance in June 2007, the size (13,000+) and status (lactating females) of the colony seem to remain relatively constant for the past 25 years.

In October 2008 and in coordination with USFWS recovery biologists and the staff of the Ozark Plateau NWR, a small, high passage within cave DL-2 was manually enlarged to about 0.45 meters wide by 0.6 meters tall. This passage was intended to provide an alternative escape route for exiting bats, particularly during high water events similar to what occurred in the summer of 2007 and 2008. A second high passage closer to the entrance was enlarged in October 2013. This short passage is about 6m long and enlarged to a consistent width of 75cm throughout its length. Occupation by the maternity colony in DL-2 will be monitored in the 2014 maternity season.

This work was undertaken to greatly reduce the threat of take that could result from the inundation of the cave passage at DL-2. It is suspected that the passage expansion provides an alternate exit route to the cave's exterior in the case of inundation of the main passage when the lake elevation reaches 752 ft. The expanded high elevation passages enhance the ability of bats to enter/exit the cave and reduce the chance of take by providing a larger exit for the bats when the main flyway is inundated. The possibility of take of non-volant young is reduced because the enlarged high passages allow easier movement of adult females in and out of the cave. The adult females, therefore, can continue to care for their non-volant young should the main flyway become inundated during the early summer. This management procedure certainly does not prevent inundation and subsequent colony evacuation, but could reduce the chance for catastrophic kills that may result from rapid inundation.

### **Long-term Management Plan: 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. It is the only maternity colony of gray bats in the state that is not protected from human entry by a gate/grill system. In October 2013 a visit was conducted and permission to access the site with vehicles and equipment was obtained from private landowners. Project personnel are confident that the Oklahoma Chapter of the Nature Conservancy is the landowner on which the main entrance is located. One remaining landowner will be contacted in 2014 in an attempt to obtain complete vehicular access to the site to begin construction of an internal gate/grill system.

### **Gate Repair: Cave DL-39**

There are two entrances to this cave system that has 5,550 of mapped passage. The cave contains an active stream that flows its entire length, and though it is subject to flooding in extreme rain events, it does house a colony of gray bats with as many as 11 roost sites within the passage. The colony that uses the cave has never been identified as a maternity colony because typically males, young of the year, and non-lactating females have been historically trapped at the entrance. The largest entrance to the cave is located on the Mary Looney Unit of the Ozark Plateau National Wildlife Refuge. Though the entrance/passage is not gated, the refuge's headquarters is located on the property and provides adequate protection from human entry and potential disturbance to roost sites. However, a second entrance is located on private property in T21N R24E, Delaware County, OK. This smaller entrance joins the main passage and is gated with a solid iron door. The design of this gate system prohibits any bat flight through the entrance, and potentially disrupts airflow into and out of the cave subsequently altering the internal climate of the passage. In July an initial visit was made to the site to inspect access and develop a management plan. In November 2013 permission was sought and obtained from the landowner to remove the current gate and replace it with a larger gate that permits both ingress/egress by bats and airflow. Removal of the existing gate structure began on 16 December 2013 and continued on 17 March 2014.

### **Gate Repair: Cave DL-148**

Cave DL 148 was gated by the Tulsa Regional Oklahoma Grotto in the mid 1990's. It is an aquatic site with little or no bat usage. A recent stygobytic survey in 2012 noted a single Ozark Cavefish and two Oklahoma Cave Crayfish. The high count for Oklahoma Cave Crayfish in the DL-148 system is 63, observed from cave DL-148 on 31 August 2001 (Graening et al., 2006). Because of high rainfall and flood events from the cave outflow into Dry Creek, a significant amount of the fill material around the concrete abutment had washed away over the years. The wash-out was threatening to jeopardize the integrity of the gate/grill structure's effectiveness to impede human entry into the sensitive system. On 21 September 2013 project personnel repaired the washed out fill areas around the grill using

1200+ pounds of concrete. It is anticipated that this repair will maintain the integrity of the structure.

**Colony/Species Monitoring:**

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. Monitoring at hibernacula was conducted between December 1, 2012 through November 30, 2013 and again during an extension of the project between 1 December 2013 and 31 March 2014. Summer roost monitoring was conducted from May through August 2013 at selected caves to determine use patterns and if possible, population estimates (Table 1).

Table 1. Population estimates and species richness at select caves in eastern Oklahoma during the project period.

Date	County	Cave Number	Gated	Monitoring Results
20-Dec-12	Adair	AD-13	Yes	5 PESU
20-Dec-12	Adair	AD-15	Yes	78 PESU; 6 COTO; 1 MYSE
20-Dec-12	Adair	AD-17	Yes	3 PESU
20-Dec-12	Adair	AD-18	Yes	45 PESU; 1 COTO
23-Jan-13	Adair	AD-14	Yes	265 PESU; 1 COTO; 2 MYSE
23-Jan-13	Adair	AD-125	No	30 PESU; 130 COTO
1-Feb-13	Cherokee	CZ-18	No	292 PESU
1-Feb-13	Cherokee	CZ-19	No	6 PESU
23-May-13	Adair	AD-13	Yes	60 COTO (Emergence)
13-June-13	Adair	AD-153	No	139 COTO (Emergence)
17-Feb-13	Adair	AD-29	Yes	7 PESU
17-Feb-13	Adair	AD-30	Yes	18 PESU
17-Feb-13	Adair	AD-54	Yes	30 PESU; 1 COTO
17-Feb-13	Adair	AD-211	Yes	17 PESU; 1 COTO
17-Feb-13	Adair	AD-221	Yes	85 PESU; 5COTO
27-June-13	Delaware	DL-2	No	12,410 MYGR (Emergence)
27-June-13	Delaware	DL-91	Yes	13,810 MYGR (Emergence)
22-Aug-13	Delaware	DL-2	No	2 MYGR (Emergence)
22-Aug-13	Delaware	DL-91	Yes	29,905 MYGR (Emergence)
30-Dec-13	Adair	AD-29	Yes	3 PESU
30-Dec-13	Adair	AD-30	Yes	15 PESU
30-Dec-13	Adair	AD-54	Yes	26 PESU; 1 COTO
30-Dec-13	Adair	AD-211	Yes	5 PESU
30-Dec-13	Adair	AD-221	Yes	69 PESU; 7COTO
25-Jan-14	Adair	AD-7	No	18,280 MYGR (Guano); 1 EPFU; 149 PESU
29-Jan-14	Adair	AD-8	Yes	10,693 MYGR (Guano)
13-Feb-14	Ottawa	OT-13	Yes	14,971 MYGR (Guano)
19-Feb-14	Delaware	DL-91	Yes	20,912 MYGR (Guano)
22-Feb-14	Delaware	DI-3	Yes	3 PESU
22-Feb-14	Delaware	DL-4	Yes	7 PESU
22-Feb-14	Delaware	DL-8	Yes	No bat usage
22-Feb-14	Delaware	DL-21	No	19 PESU

MYGR: *Myotis grisescens*  
 MYSE: *Myotis septentrionalis*  
 EPFU: *Eptesicus fuscus*

COTO: *Corynorhinus townsendii ingens*  
 PESU: *Perimyotis subflavus*

**Stygobitic Bioinventories**—Dr. Fenolio has been assisting the U.S. Fish and Wildlife Service with subterranean surveys and bioinventory work since 2001. In particular, regular counts of habitats containing populations of Ozark Cavefish, and both state endemic cave crayfish, Oklahoma Cave Crayfish and Delaware County Cave Crayfish, have been a focus of these surveys. Other work has included bioinventories of select caves where either said work had not been performed or further bioinventory work was desirable. Target systems are identified annually by biologists from the Ozark Plateau National Wildlife Refuge and from the U.S. Fish and Wildlife Ecological Services Office in Tulsa, OK. Data collected from these efforts are provided to the Subterranean Biodiversity Project databases. The 2013/2014 Ozark aquatic cave life surveys were originally planned for December. Owing to the ice storms during that period, the trip was rescheduled to January 2014. A blizzard cut this effort short by three scheduled days and continuation of the work past January 4, 2014 was canceled because of inclement weather.

**Cave SQ-1, January 2, 2014**

This cave has been a high priority system for bioinventory work owing to the fact that there are old and unconfirmed reports of blind cave fish. Our visit to the system happened during a “dry” period and water levels in the system’s aquatic system were pooled and not flowing. All pools in the system were checked for aquatic wildlife but no cave fish were observed. One Ozark Big-eared Bat was flying around the system before we entered the system and after the gate was unlocked and opened (gate was constructed by the Tulsa Grotto prior to the initiation of this grant).

Table 2. Biological inventory for cave SQ-1 in Sequoyah County, Oklahoma

Biological Inventory	Identification	No.
Crane Fly	Tipulidae	1
Mosquitoes	Culicidae	50
Hothouse Millipede	<i>Oxidus</i> sp.	2
Fungus Gnat larvae	<i>Macrocera nobilis</i>	4
Cave Fly	Heleomyzidae	10+
Cave Beetle	<i>Ptomaphagus</i> sp.	5
Cave Harvestman	<i>Crosbyella</i> sp.	31
Grotto Salamander larvae	<i>Eurycea spelaea</i>	2
Aquatic larval salamanders	<i>Eurycea</i> sp.	15
Dark Sided Salamanders	<i>Eurycea melanopleura</i>	3
Cave Salamander	<i>Eurycea lucifuga</i>	4
Tricolored Bat	<i>Perimyotis subflavus</i>	126
Ozark big-eared Bat	<i>Corynorhinus townsendii ingens</i>	5



### Cave DL-14, January 3, 2014

This Cave has a small aquatic system that flows through it which contains a diverse community of aquatic cave organisms. If a large storm passed though, there is a chance that the entrance would no longer be passable.

Table 3. Biological inventory for cave DL-14 in Delaware County, Oklahoma

Biological Inventory	Identification	No.
Aquatic Cave Isopods	<i>Caecidotea sp.</i>	18
Hothouse Millipede	<i>Oxidus sp.</i>	1
Fungus Gnat	<i>Spelobia sp.</i>	1
Cave Fly	Heleomyzidae	5
Cave Crickets	<i>Ceuthophilus sp.</i>	5
Grotto Salamander larvae	<i>Eurycea spelaea</i>	3
Cave Salamander larvae	<i>Eurycea lucifuga</i>	1
Tricolored Bat	<i>Perimyotis subflavus</i>	11
Big Brown bat	<i>Eptesicu fuscus</i>	1

### Cave AD-7: January 4, 2014

This cave owned by the Nature Conservancy and a private party is located in T15N R24E, Adair County, OK. The site annually serves as a maternity cave for a colony of gray bats and torpid individuals of multiple other species in winter. It is the only maternity colony of gray bats in the state that is not protected from human entry by a gate/grill system.

Table 4. Biological inventory for caves AD-7 in Adair County, Oklahoma

Biological Inventory	Identification	No.
Dipluran	<i>Litocampa sp.</i>	1
Springtail	Collembolans	10
Hothouse Millipede	<i>Oxidus sp.</i>	20
Fungus Gnat	<i>Spelobia sp.</i>	5+
Web Worms	<i>Macrocera sp.</i>	50+
Cave Beetle larvae	Platynus sp.	5+
Cave Beetle	<i>Ptomaphagus sp.</i>	10+
Cave Harvestman	<i>Crosbyella sp.</i>	30+
Cave Orb Weaver Spider	<i>Meta sp.</i>	30+
Small Spiders	<i>Phanetta</i> or <i>Eidmanella</i>	50+
Large Spiders	<i>Cicurina</i> or <i>Liocranoides</i>	20+
Pseudoscorpion	<i>Hesperochnes sp.</i>	100+
Cave Crickets	<i>Ceuthophilus sp.</i>	10
Bladetooth Snails	<i>Patera sp.</i>	10+
Tricolored Bat	<i>Perimyotis subflavus</i>	165
Big Brown bat	<i>Eptesicu fuscus</i>	2
Ozark Big-eared Bat	<i>Corynohrinus townsendii ingens</i>	1

#### E. Discussion and Recommendations:

1. Cave AD-7 in Delaware 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 securing access across private properties is a crucial step in providing long-term protection to the critical bat roosts inside the cave. Once these are established, planning needs to begin in an expeditious manner to install gate/grill systems inside the cave's respective entrance's and passages.
2. Construction on the gate to the private entrance to cave DL-39 should continue through completion. The original solid steel gate does not allow ingress/egress to bats or support unobstructed airflow.
3. Annual monitoring of 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.

4. The limestone bluff line west of the opening to cave DL-74 has several small karst windows. They have groundwater that can be seen from the surface. They should be investigated for *C. subterraneus* when surveys are performed. In an effort to maintain productive landowner relationship at cave DL-74, images of the cave fauna should be provided to the Carroll Family. Prints will be made and sent to the U.S. Fish and Wildlife Service to deliver to them at a later date.
5. Care should be taken by anyone working in McGee's Cave not to step on the chert pile at the front of the pool owing to juvenile Ozark Cavefish utilizing the rocky microhabitat and its interstitial spaces. Much removal of timber has been conducted around caves DL-148 and McGee's Caves. Observing the progression of the habitat alteration closely is suggested as the activities could impact the systems.
6. Considerable emphasis by multiple government agencies is being placed on pre-WNS management and monitoring in states where the vector is likely to be detected in the near future. Oklahoma is considered one of those states. Monitoring torpid populations and surrounding substrate is an appropriate extension of this project if funding persists. Construction of gate/grill systems in cave passages effectively removes the threat of human transmission between caves in pre-WNS areas.
7. In Oklahoma, the northern long-eared bat (*Myotis septentrionalis*) is a tier II species of greatest conservation need (criteria 2 and 3) in the state's Comprehensive Wildlife Conservation Strategy. More specifically, it is a SGCN in 9 of 11 Conservation Landscapes in the Ozark Region of the Comprehensive Wildlife Conservation Strategy. In each landscape the species is identified as having an unknown status and trend. Northern long-eared bats in Oklahoma 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. It is anticipated that information on the species will continue to be gathered by government entities as consideration for potential listing intensifies. If so, cave management efforts to protect cave-dwelling populations of the species from human activity, and management and containment of potential transmission of WNS should become a significant aspect of this project, if it continues (Caceres and Barclay 2000).

## E. Significant Deviations:

There were no significant deviations from the stated objectives.

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