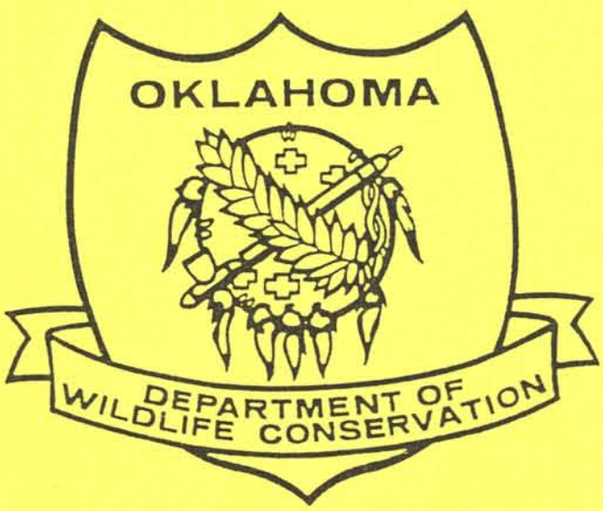
PERFORMANCE REPORT

SECTION 6

ENDANGERED SPECIES ACT



FEDERAL AID PROJECT E-22-7

MANAGEMENT AND CAVE PROTECTION FOR THE
OZARK BIG-EARED BAT AND GRAY BAT IN OKLAHOMA

OCTOBER 1, 1999 - SEPTEMBER 30, 2000

PROJECT REPORT

STATE: Oklahoma PROJECT NUMBER: E-22-7

PROJECT PERIOD: 1 October 1999 – 30 September 2000

PROJECT TITLE: Management and Cave Protection for the Ozark Big-eared Bat (*Corynorhinus townsendii ingens*) and Gray Bat (*Myotis grisescens*) in Oklahoma

PROJECT OBJECTIVE: To locate, determine ownership and develop and implement cave protection management plans for Ozark Big-eared and/or gray bat caves in Oklahoma.

INTRODUCTION:

Of the 45 species of bats found in North America, about 18 rely substantially on caves throughout the year. Thirteen of these species utilize caves year-round. These caves are utilized as winter hibernacula, stopover roost sites during migration, summer roost sites, or maternity sites where adult females give birth to their young. All North American bats listed as endangered or threatened by the U.S. Fish and Wildlife Service are cave dwelling species or subspecies (Harvey et al 1999; McCracken 1989; Pierson, 1999). Two cave-dwelling 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 interest in Oklahoma. Each is federally listed as endangered by the U.S. Fish and Wildlife Service (1982, 1984, 1995). The gray bat and the Ozark big-eared bat are both obligate, year-round cave-dwelling bats. The Indiana bat hibernates in caves in winter and disperses during non-hibernating months to form roosts under bark and in tree cavities in hardwood forests (Humphrey et al 1977; Kurta et al 1993; Laval and Laval 1980).

Persistent or casual human disturbance at maternity caves and hibernacula continues to be implicated as a cause for the decline in population of most cave-dwelling bats (Am. Soc. of Mamm. 1992; Barbour and Davis,1969; Humphrey and Kunz 1976; Tuttle 1979). Disturbance at these caves may induce elevated mortality rates, poor recruitment, and actual colony abandonment. At hibernacula, premature arousal from bouts of torpor and hibernation ultimately consume stored energy reserves. Disturbance at maternity colonies adversely affects thermoregulatory requirements of non-volant developing young. Low reproductive rates, long generation times, and concentrations of populations in localized roosts are life-history characteristics indicative of North American cave-dwelling bats (McCracken 1989; Am. Soc. of Mamm. 1992; Thomas and Bergeron 1990; Tuttle 1976; U.S. Fish and Wildlife Service. 1982). Such life histories and adverse effects of human disturbance present difficult challenges as wildlife managers and bat conservationists develop management objectives for protecting and recovering declining bat populations.

Contemporary efforts for bat conservation are concentrated on protecting caves and the various types of bat colonies that they house (Am. Soc. Mamm. 1992). Most often these protection measures are intended to eliminate disturbance resulting from

human entry into caves. Protection is typically accomplished by construction of gates at cave entrances, fencing of cave entrances, placing warning signs at entrances, and maintaining a close and positive rapport with private landowners. Protection for cave-dwelling bat populations by placing gates in the entrances of caves can be an effective, immediate, and long-term method to deter human access to critical bat roosts.

Twenty-two entrances to caves in eastern Oklahoma are presently protected with the use of internal gate designs. Five of these caves are inhabited by colonies of gray bats. Twelve caves inhabited by Ozark big-eared bats, and a single hibernaculum of Indiana bats are similarly protected. Additionally, four caves that contain populations of Ozark cavefish (*Amblyopsis rosae*) and Ozark crayfish (*Cambarus* sp.) are protected from human entry and vandalism by internal gates.

Each of the 22 caves that have been gated in Oklahoma has unique physical characteristics regarding passage size, location of the nearest bat roost to the entrance, and number of entrances used by bats. Internal gates are placed in such a manner as to protect the nearest historical roost area to the cave entrance. Gate distances from cave entrances range from 3-17 m. Passage area where gates are located range from 1.38 m^2 – 9.5 m^2. In contrast to some gates protecting gray bat colonies in the southeastern United States that do not completely fill the cave passage, all internal gates in Oklahoma caves completely fill cave passages. Furthermore, one of the gray bat caves that are gated in Oklahoma has two entrances that are used during entrance and exit by bats. In this particular cave, both of the entrances are protected with complete gates. Relatively small colony sizes (<30,000), relatively small gated passages, and internal positioning of grill structures probably contribute to the apparent acceptance of full passage gates by resident bat populations in eastern Oklahoma.

Although placement of gates within "dark zones" of cave passages may be the most effective method to deter human access to critical bat roosts, their effects on resident bats and microclimate of cave interiors have not been measured completely (Humphrey 1978; Richter et al 1993;Tuttle 1977; Tuttle and Stevenson 1977). Various designs of gate construction and resulting effects on bat flight have been tested (White and Seginak 1987). However, effects that gates have on the microclimate of cave interiors have not. It is suspected that cave gates alter airflow in cave passages. Altered airflow, in turn, may affect ambient temperature, humidity, and substrate temperature. Roost substrate temperatures influence body temperature and ultimately metabolic rates of hibernating bats (Humphrey 1978;McNab 1974;Richter et al 1993). Fetal and neonatal growth rates are affected directly by sub-optimal temperatures of pregnant females and juveniles. Poor thermoregulation in these bats may result in slow maturation, thus reducing survival and natality (Humphrey 1975;Studier and O'Farrell 1972). Also it is suspected that cave gates interrupt or impede the exit of large colonies of bats from roost caves. An increase in swarming activity before exiting or entering a cave that is gated may increase the risk of predation (Tuttle 1977, 1979;White and Seginak 1987).

The primary objectives of this project are the identification of caves that are considered critical habitat for Ozark big-eared bat and gray bat colonies in northeastern Oklahoma. Management/protection plans for one to three of these caves are developed and implemented during the project year as funding and time allow. These

management/protection plans are coordinated with the appropriate landowners and may include posting a warning sign at the cave entrance, placing human restrictive structures at or within the cave such as fencing around cave entrance or constructing a gate/grill structure within the cave. Each cave is monitored to determine the effectiveness of the management plan, particularly gated caves, to determine the impact of the structure or other protection measures implemented at the site. As problems are identified with the cave protection plans, they will be corrected. In an attempt to address effects of cave gates on bat populations in northeastern Oklahoma, an additional component of this project is to collect data to compare internal ambient temperature, relative humidity, substrate temperature, and emergence times of bat flight between gated and non-gated caves.

PROCEDURES:

- Proposed objectives listed below are designed to accomplish task B 1.6 and 1.7 of the 1993 Revised Ozark Big-eared Bat and Virginia Big-eared Bat Recovery Plan, and objectives 1, 1.2, 1.3.1, 3, and 3.2 of the 1982 Gray Bat recovery plan.

1. The current landowner of each site will be identified, and after determined, proposed plans for the specific site will be discussed and permission to implement those plans will be sought.
2. Determine the projected cost for the implementation of the recommended management plan.
3. Obtain approval of the proposed maintenance plan from all pertinent agencies including the Oklahoma Department of Wildlife Conservation Wildlife Diversity Program, the U.S. Fish and Wildlife Service and individual landowners of each site.
4. Upon approval of the maintenance plan for each site, the plan will then be implemented. Implementation of individual management plans will be determined on a priority basis. This priority will depend on the ability to effectively utilize available funds, in conjunction with the amount of human disturbance each site is receiving and the status of the population of Ozark big-eared bats or gray bats inhabiting the site.
5. Each site where structures are placed for protection will be monitored twice annually after installation. One inspection will be conducted during the uninhabited season to inspect the structure or structures for possible vandalism. An additional monitoring visit will take place while the bats are utilizing the site. These surveys will be conducted as exit counts at maternity sites using infrared lighting and night vision scopes. This type of survey accurately determines the population of Big-eared bats using the site and if the newly constructed structures are inhibiting the flight of the bats into and out of the site.
6. Reports of the progress of each management plan will be submitted to the Oklahoma Department of Wildlife Conservation Wildlife Diversity Program and the U.S. Fish and Wildlife Service. A final report will be submitted after the fifth project year. An annual performance report will be submitted at the end of each

segment year.

- The following is a description of caves and procedures that were involved in the project during the 1999-2000 project year.

  Site: OT-13: Presently this cave serves as a maternity site for the endangered gray bat. Guano measurements taken in 1999 estimate the colony population to be about 14,000 bats. The popularity of the cave with local recreational caving groups and a local Boy Scout camp is well known. Ownership of the cave is private. The landowner lives out of state and rarely visits the site. He has recently been contacted concerning management plans intended for the cave. He granted permission to install an internal gate/grill system inside the cave. Installation of the grill system began in March and was completed in April 2000. Although the entire flyway was enclosed with the grill system, the actual gate construction that allows researchers access to the cave interior will be installed in November 2000. Increased bat usage in early April precipitated the need to delay the installation of the gate until a later date.

  Prior to installing the grill system, continuous data loggers were placed inside the cave to collect ambient temperature, substrate temperature, and relative humidity data. These conditions were monitored during the entire months of August and December 1999. Data loggers were then placed at identical roost sites for one month before, and after the installation of the grill system was completed in April 2000. Data from these pre-, and post-gating observations may give some indications on the effects that internal gating systems have on ambient cave environments.

  Site: AD-220: This cave has been used historically by a population of gray bats estimated at between 500-1,000. Past landowners have covered the entrance with a solid iron door to discourage human entry into the cave. Only a small 30-40 cm opening at the top of the door is available for entry by bats. Airflow through the entrance has been altered severely. The present landowner gave permission for the door to be removed to allow greater access for bats. This is a rare opportunity to study effects that an inappropriately placed gate has on ambient cave environments and any respective population of bats. Internal ambient climatic conditions were recorded during September 1999 and March 2000 using data loggers. Ambient conditions to be monitored are relative humidity, substrate temperature, and ambient temperature. Additionally, ambient conditions were recorded one month before and one month after removal of the existing structure, which took place in April 2000. The landowner also has agreed to allow installation of an internal gating system in the event that a population of bats may return to the cave.

  Ambient Cave Climatic Data: During the project year, ambient surface (temperature and relative humidity) and internal cave conditions (temperature, relative humidity, and substrate temperature) were monitored at three gated (AD-

8, AD-14, and CZ-9) and three non-gated caves (AD-7, AD-17, and OT-13). Gray bat populations utilize four of these caves. The remaining two caves are used by small numbers of Ozark Big-eared bats. As stated above, cave OT-13 was gated with an internal grill system during spring 2000. Monitoring ambient conditions continued at this site for post-gating and pre-gating data during the summer 2000. An additional cave was therefor used as the third non-gated cave in which to measure ambient conditions. This cave was AD-220 and is described at length above as well. Conditions at each cave were monitored for 7 consecutive days each in December 1999 and January 2000, and again in July-August 2000. Any structure that alters the entrance of a cave will affect airflow into and out of the cave. In some instances, improper gating of caves has contributed to reduced bat use by altering necessary airflow for maintenance of appropriate ambient conditions (Tuttle 1977; Tuttle and Stevenson 1977). Designed experiments and quantitative data on effects of cave entrance modifications on internal cave microclimates, such as cave gates, are limited if not non-existent (Richter et al. 1993). Analysis of this data may help in determining if Internal ambient climatic conditions of cave environments are affected by human restrictive gating systems placed in cave passages.

Exit Data: Emergences at three gated caves (AD-8, CZ-9, and OT-13) and three ungated caves (AD-7, DL-2, and DL-39) were monitored to determine emergence initiation times of respective gray bat populations. Exit data were recorded on three occasions for each of six caves in June-July 1999, and 2000. All data were collected within a 6-week period. It has been speculated that placing gates in cave entrances increases the swarming behavior of bats as they enter and leave a cave. This behavior may lead to an increase in predation by snakes and small mammals as bats try to fly through the gated entrance (Tuttle 1977; White and Seginak 1987). During this study, non-intrusive monitoring of flight emergence times was conducted using an infrared light source and night-vision optics. These surveys are an attempt to determine whether the presence of internal gating systems inside cave passages has an effect on initiation of flight exit from roost caves inhabited by gray bats.

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