

ARKANSAS GAME AND FISH COMMISSION

**STRATEGIC
NONGAME MAMMAL MANAGEMENT PLAN**

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STRATEGIC
NONGAME MAMMAL MANAGEMENT PLAN

Prepared by

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PREFACE

A team of Arkansas Game and Fish Commission (AGFC), University of Arkansas-Little Rock, Arkansas Tech University, and U.S. Forest Service professional biologists, most with years or decades of experience with nongame mammals, developed this plan. Agency staff thoroughly reviewed this document prior to its adoption by the Commission.

The purpose of this plan is to provide strategic, long-term guidance and direction for the Commission's nongame mammal program. Operational planning based on priorities in this strategic plan will occur annually, in conjunction with the AGFC budget process and biennially in conjunction with biennial personnel requests. This strategic plan is intended to guide nongame mammal programs for ten years, and will be evaluated and formally updated on a five-year cycle. However, dynamic changes to address specific problems may be necessary in the interim.

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INTRODUCTION

HISTORY:

Arkansas is home to 48 species of nongame mammals (Appendix 1) though only mountain lions were regularly mentioned in early accounts of Arkansas wildlife; the others were generally overlooked due to their lack of commercial value and cryptic habits. The first serious study of these species began in the 1930s, when J.D. Black, of the University of Kansas began researching bats and terrestrial small mammals (e.g., Black 1934, Black 1936). From the 1950s to the 1970s, Dr. John Sealander, University of Arkansas, was the primary mammalogist in the state, undertaking numerous nongame mammal research projects (e.g., Sealander 1951, Sealander and Young 1955, and Sealander and Heidt 1990). Dr. Gary Heidt, University of Arkansas-Little Rock, and Dr. Rick McDaniel, Arkansas State University have directed most nongame mammal research in Arkansas from the early 1970s to the present.

Although the AGFC was granted authority over all wildlife in the state by Amendment 35 to the state constitution in 1945, there were no regulations or management activities conducted specifically for nongame mammals until after the passage of the federal Endangered Species Act in 1973. In 1976, the AGFC and the U.S. Fish and Wildlife Service signed an agreement under Section 6 of this Act to implement joint research and management programs for endangered species. The AGFC used money provided by the federal government under this agreement as the primary source of funding for all nongame projects until the late 1990s.

One of the first nongame research projects funded by the agency was a survey of endangered bats in Arkansas by Dr. Michael J. Harvey, Tennessee Tech University (then of Memphis State University). This monitoring project has continued since 1978 and has given Arkansas an excellent record of changes of endangered cave bat populations.

The AGFC formed an Endangered Species Program within the River Basins Division in 1977. Harold E. Alexander served as Program Coordinator, and was assisted by biologist Sam Barkley. When Alexander left the agency to become a consultant ca. 1984, the program was renamed the Endangered Species, Nongame, and Urban Wildlife Section, with Barkley being promoted to Program Coordinator. Karen Rowe, who had started with the AGFC as the urban biologist in 1985 and had become the nongame biologist in 1989, assumed the duties of Program Coordinator ca. 1995.

This program faced a large hurdle in that most people didn't realize the AGFC was responsible for nongame and endangered species. Seventy-four percent of people responding to a 1984 survey said that they were unaware the AGFC had responsibility for the protection of the state's endangered species, while 54% were not aware of the AGFC's responsibility for other nongame wildlife such as songbirds. However, this same survey revealed that 52% of survey participants wanted more protection of endangered species (4% wanted less) and 48% wanted more protection of nongame species (2% wanted less). When asked to rate the Commission's protection of non-game

wildlife, 9% said that it was excellent, 21% good, 34% fair, 8% poor, and 28% did not respond or did not know (UALR 1984).

Early nongame management activities focused on protection of caves used by endangered bats. In cooperation with the Arkansas Natural Heritage Commission and the Arkansas Field Office of The Nature Conservancy, the AGFC used Section 6 funding to construct fencing around one gray bat cave and to build a gate at an Ozark big-eared bat maternity cave in the mid-1980s. In 1990 the Commission gated a cave containing the state's largest Indiana bat hibernaculum and worked with the Arkansas Department of Parks and Tourism to install an alarm system at Ozark big-eared bat caves at Devil's Den State Park.

The AGFC recognized the importance of education in endangered species recovery and produced brochures in 1983 and a poster in 1986 featuring endangered species. In 1986, the AGFC published, Arkansas Bats: A Valuable Resource, by Dr. Michael J. Harvey. Expanded versions containing information and photos of bats of the eastern United States (1992) and of the entire nation (1999) have followed this very successful booklet. A 1996 *Arkansas Wildlife* article, "Here Today...A Guide to Arkansas's Endangered & Threatened Animals" was reprinted as a source of general information on endangered wildlife, including three endangered bats. In 1998, armadillos and flying squirrels were featured in new AGFC brochures and various articles about chipmunks, shrews, armadillos and moles have been published in *Arkansas Wildlife* in recent years.

Though still suffering from negative stereotypes, bats are of increasing interest in the state. An overwhelming number of requests to the AGFC Project Wild office for bat talks prompted the agency to produce a video on Arkansas bats in 1993. Bat houses are growing in popularity; over 100 people asked for bat house plans after a recent AGFC press release. The nation's leading bat conservation organization, Bat Conservation International, has 64 members based in Arkansas and for the last eleven years Devil's Den State Park has held annual Bat-o-Rama festivals attended by an average of 677 visitors/year.

While campaigning for the passage of the constitutional amendment providing a portion of a 1/8th cent sales tax to the AGFC, the agency learned that people wanted more effort put towards protection of nongame and endangered species. Following passage in 1996, the AGFC met this need and expanded its nongame commitment from one biologist to six by June 2000. The Nongame, Endangered, and Urban Wildlife Section was absorbed into the Programs Sections of the Wildlife Management and Fisheries Management Divisions in 1998 and Blake Sasse was hired as the agency's first Nongame Mammal Program Coordinator in January 2000.

Citizen support for endangered species protection remains strong. A 1999 survey found that 82% of Arkansas residents said that managing endangered species was a very important activity for the Commission, and 54% thought that more time and resources should be spent on these programs. Fifty percent of respondents stated nongame species

were very important and 34% thought that more resources should be spent on managing these species (Responsive Management 1999).

POPULATION MONITORING TECHNIQUES:

Because of their small size and secretive and nocturnal habits, monitoring populations of most nongame mammals is difficult. Cave-dwelling bats are the most easily located of these species and the AGFC has sponsored monitoring of endangered bats using caves since 1978. During winter, two main methods are utilized: direct counts of small numbers of bats, and estimating bat numbers by measuring or estimating the area covered by hibernating bats and multiplying this by a standard density measure. Gray bats and Ozark big-eared bats also use caves during the summer and are counted as they exit at dusk, sometimes with the help of night-vision equipment.

Non-cave dwelling bats are much more difficult to monitor as they usually occur in relatively low numbers and their roost sites are rarely found. An index of bat population changes could be created based on using mist net captures that would allow managers to assess patterns of distribution and also large fluctuations in populations of many species. Advances in the miniaturization of radiotransmitters have allowed researchers to follow bats back to their roost sites where populations can be monitored. However, this method is time-consuming, expensive, and is impractical for large-scale monitoring efforts. Mark-recapture studies to estimate population size are not useful due to the very low rate at which marked bats are recaptured. Perhaps the most promising monitoring method for tree roosting bats will be to document habitat needs and evaluate changes in potential habitat using geographic information system models when quantitative data becomes available.

One technology with great potential for determining presence or absence of bats without the need to capture them are ultrasonic bat detectors that sense their echolocation signals used for navigation and foraging. After developing a “library” of known calls for a given area, it is possible to identify species in a consistent and objective manner. Computer software used for analysis of these calls is rapidly advancing and this may become a practical method for monitoring bats on a large-scale basis in the near future.

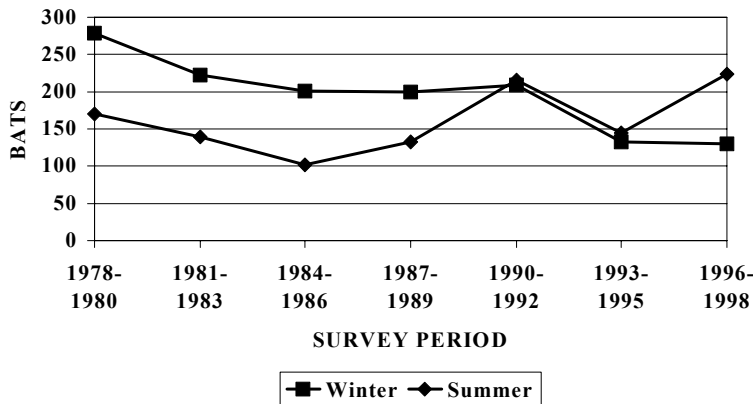
Many terrestrial small mammals can be readily captured with the use of live traps, pitfall traps, or snap traps, or their presence can be inferred from tracks or burrow/nest indices. These species often undergo dramatic population swings in a very short time and the amount of effort necessary to reliably document long-term changes in populations over a large scale is often prohibitive.

POPULATION STATUS AND TRENDS:

Information on population trends of the majority of nongame mammals in Arkansas is nonexistent. Several terrestrial species are increasing in distribution; the armadillo has expanded its distribution since being first recorded in 1921 to cover the entire state, and the western harvest mouse and prairie vole appear to have utilized manmade corridors such as railway rights-of-way, highways, and power lines to enlarge their historic ranges. The Florida panther has been extirpated from Arkansas (McBride et al. 1993) but there is some recent evidence of small numbers of free-ranging mountain lions in the state (Witsell et al. 1999). Three exotic nongame mammals have become established in Arkansas since European settlement: the black rat, Norway rat, and house mouse (Sealander and Heidt 1990).

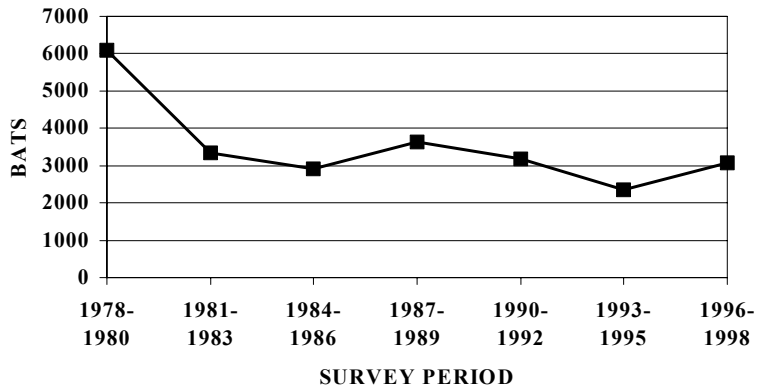
The Ozark big-eared bat has been declining across its range in Oklahoma, Arkansas, and Missouri (U.S. Fish and Wildlife Service 1995). Although the total known population increased in recent years, this was due to the discovery of several previously unknown caves used by this species, and the primary population in Marion County has continued to fall (Figure 1). Indiana bat numbers in Arkansas dropped by about 50% between the 1978-1980 and 1981-1983 survey periods, though they have remained stable since then (Figure 2). Gray bat populations remained fairly constant from 1978-1995, but protection efforts at a few hibernacula have led to large increases in winter populations in the late 1990s (Figure 3).

Figure 1. Ozark big-eared bat population estimates, 1978-1998.



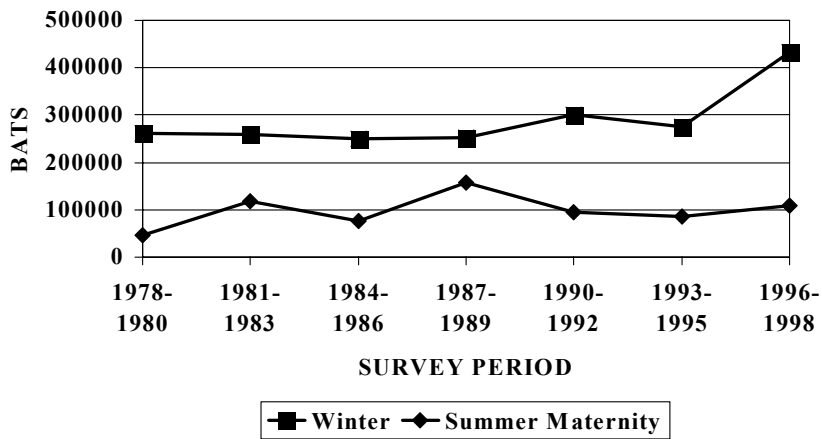
Note: This table is based on the sum of average population estimates for all caves surveyed in each survey period.

Figure 2. Indiana bat winter population estimates, 1978-1998.



Note: This table is based on the sum of average population estimates for all caves surveyed in each survey period.

Figure 3. Gray bat population estimates, 1978-1998.



Note: This table is based on the sum of average population estimates for all caves surveyed in each survey period.

Nongame Mammal Management Issues and Problems:

- **Knowledge of the current statewide distribution and status of some nongame mammals is minimal.**

Arkansas is at the edge of the natural ranges of several nongame species and records of species such as the desert and southeastern shrews, Ozark pocket gopher, and the plains and eastern harvest mouse are too few to accurately assess their current status in the state. Others, such as the small-footed bat, are rarely found during surveys, possibly due to use of habitats rarely sampled and an evidently solitary lifestyle. Additional information is needed on these and other species to ensure proper conservation actions are implemented and to aid in determining if additional protection is necessary.

- **Information on the habitat requirements of some bat species is limited.**

Miniaturization of radiotelemetry transmitters in the late 1980s allowed scientists to begin to track small bats during nighttime foraging bouts and learn about the natural roosts of tree-dwelling bats. This advance in technology has primarily been used on endangered bats and only in recent years has it been used with species such as southeastern and Rafinesque's big-eared bat. Additional information is necessary on forest-dwelling bats in all Arkansas ecoregions. While Arkansas has been a leader in monitoring endangered cave bat populations, we do not have adequate information on the habitat inside and near these caves that make them suitable for these species. Similar information is also necessary for species thought to be more common such as the pipistrelle or northern long-eared bat.

- **Recreational use of caves can negatively impact bat populations.**

Disturbance to hibernating populations has been a major cause in the decline of endangered bats. Arousal during this period can cause bats to use a significant amount of the energy necessary for survival until spring. Large concentrations of hibernating bats or aggregations of female maternity colonies in caves also makes them vulnerable to intentional harm from humans. Documented cases of vandalism include bats having been killed with shotguns, torches, and switches. Much more likely is that frequent visitation drives bats from preferred caves and forces them to use less suitable locations. However, at sites such as Blanchard Springs Cavern we have found that it is possible for both humans and bats to use caves, though only by strict, direct oversight of visitor activities during the summer and complete protection from disturbance during the winter.

- **Baseline information on public knowledge, attitudes, and interactions with nongame mammals and their management is lacking.**

In past surveys the citizens of Arkansas have expressed an interest in increasing effort on nongame wildlife and endangered species programs, but we lack any information on the public's current state of knowledge of these species on our programs. Baseline and follow-up surveys are necessary in order to judge the success of agency information, education, and management programs. New nature centers operated by the AGFC around the state will allow for education of visitors concerning both game and nongame wildlife resources of the state.

- **Migratory bats may be threatened by conditions encountered outside the state of Arkansas.**

Several Arkansas bats, such as the Indiana bat, silver-haired bat, and hoary bat are migratory. Conservation measures taken in Arkansas may not be adequate for protection of these species. For example, Indiana bat populations hibernate in Arkansas, with females migrating to Missouri during the summer where they form breeding colonies. It has been suggested that the reason Indiana bat populations have not increased in caves protected by gates or fences is that suitable summer habitat for females has been lacking.

- **Modern timber management may not provide adequate habitat for forest-dwelling bats and terrestrial small mammals.**

Intensive management of forest lands for wood products reduces nongame mammal habitat by eliminating hollow living trees, snags, and downed logs and by encouraging monospecific plantation tree farms. Timber harvesting in naturally regenerated stands may also have similar effects, though to a lesser extent. However, generalist species that utilize meadows and other early seral stage habitats may benefit from the use of small-scale timber harvest and/or prescribed burning.

- **Environmental contaminants may be a threat to some nongame mammals.**

The effects of environmental contaminants on small to medium sized wild mammals have been largely unstudied. It has only been in recent years that researchers have begun to study long-term effects, particularly as they affect genetic structure of populations. Because of the overall economy and physiography of Arkansas, there are several important contaminants which may be of particular importance to wildlife. These include: oil and brine pits, pesticide/herbicide application and runoff, dioxin contamination, heavy metals, and aflatoxins from fungal infection of fescue grasses. Surveys should be conducted to determine the importance and long-term effects of contaminants.

- **Human population expansion and development can negatively impact nongame mammals.**

Rapid development in parts of Arkansas can affect local populations of all nongame mammals but may pose a threat to certain bat species. In some cases, housing subdivisions have been built around the entrances to caves used by endangered bats. These developments can change the vegetation structure at cave entrances, potentially altering the internal microclimate of the cave making it unsuitable for bat use. At caves used in the summer by gray bats or Ozark big-eared bats, such development may reduce or eliminate suitable foraging habitat or alter existing flyways. Increased development can also lead to more human visits to these caves, reducing their use by bats. Habitat for cavity-roosting bats may also be reduced due to clearing of timber for house construction and removal of snags as safety hazards in populated areas.

- **Intensive cavity management in young forests and construction of artificial roosting structures may be necessary for maintenance of bat populations in areas that have undergone man-made habitat changes.**

In recent years, bat houses have become an increasingly popular management tool and researchers have begun to evaluate these and other man-made structures for their effectiveness in providing artificial roost sites for bats. In southern Arkansas, abandoned wells have been found to be important hibernation sites for Rafinesque's big-eared bat, and these sites are often filled in or capped, entombing the bats or preventing use of the site. Demonstration projects in the Delta and South Coastal Plain may encourage landowners to protect or manage for such habitat.

- **Some exotic species may pose a threat to native nongame mammals.**

Exotic and invasive species are an increasing threat to the native wildlife of the United States. For example, the red fire ant has been found to be a danger to wildlife in nearby southern states and, though present in Arkansas, potential harm to the state's wildlife has not been evaluated. Wild hogs are an occasional predator on small mammals and extensive rooting has been shown to reduce populations of short-tailed shrews.

- **Management of nongame mammals should focus on species that are rare or have limited Arkansas distributions.**

The AGFC uses the current U.S. Fish and Wildlife Service list of endangered and threatened species as the list of species protected by AGFC endangered species regulations. There are a number of other species that are rare or have limited distributions in Arkansas that would benefit from official recognition as "species of special concern" in the state. Such designation would help prevent these species from becoming endangered by making sure their needs are taken into

consideration when making wildlife habitat planning decisions, evaluation of the impacts of other projects, and in focusing research efforts.

- **Bats, gophers, and other nongame mammals are occasionally considered nuisance animals.**

In areas where the availability of natural habitat has been reduced, some species of bats are known to roost in the attics or walls of homes, businesses, or barns. While the threat of actual harm to the landowner is low, odor from guano accumulations is annoying and bats occasionally wander into living quarters in homes. Gophers and other terrestrial small mammals have been known to cause damage to underground cables, crops and fields. While free-ranging mountain lions are rare in Arkansas (and their origin much in doubt), the AGFC receives numerous complaints attributed to mountain lion presence and depredation. While the Commission strictly regulates nuisance furbearer control agents, those working with nuisance nongame mammals are most often commercial pest control workers operating under the auspices of the Arkansas Plant Board. These operators often lack any biological training or knowledge of nongame species and may not be aware of AGFC authority over their work with these animals and of practices allowable under our regulations.

- **The AGFC scientific collection permit process has not been used to its full potential for documenting the locations of rare species.**

In order to collect animals in Arkansas, researchers are required to obtain a scientific collection permit from the AGFC. Annual reports are required of those granted permits but those submitted vary widely in their level of detail and usefulness to the AGFC or the scientific community. In seven of twenty reports recently examined, species that the Arkansas Natural Heritage Commission (ANHC) has designated as inventory species due to their rarity, were captured, but none of these reports contained a sufficient level of detail to accurately include them in the ANHC's database. Many bat researchers use bands to track movements and survival of captured individuals, but are not required to report banded bats to the AGFC or any other central authority that could coordinate reporting recoveries to the original bander.

- **The AGFC lacks the ability to track nongame wildlife regulation violations by species.**

The current AGFC violation database, maintained by the Division of Law Enforcement, tracks violations by the regulation number given in the Code Book. For game such as deer or turkey there are regulations particular to that species, and it is possible to determine trends in violation numbers and types for those specific species. In contrast, most nongame regulations are broad and not species specific. For example, there is a prohibition on taking endangered species (code 19.12), but we cannot determine what species were taken from information found

on the violation notice. This basic information is needed to track trends in violations in order to assess threats to nongame wildlife and to target AGFC education and enforcement efforts.

- **The impact on nongame mammal populations of current wildlife pet regulations has not been assessed and survival rates of captive wildlife are unknown.**

The AGFC wildlife pet regulation (18.17) allows up to 6 individuals per household of most native nongame mammal species to be kept as pets. No information is available on the number and type of animals removed from the wild under this regulation, or whether it may have an effect on statewide populations. Most wildlife species are not normally considered pets in the United States and owners may or may not know how to properly care for them. Research on the survival rates of captive wildlife, attacks on humans, and disease transmission is necessary to determine if certain species would be better served by removal from the list of allowable pets.

- **Injured or abandoned wildlife are being cared for and released by wildlife rehabilitators without AGFC regulation or oversight.**

Rehabilitation of injured wildlife is an increasingly popular activity in the United States. In Arkansas, rehabilitators are allowed to possess certain species under the wildlife pet regulation, but there is no specific regulation governing rehabilitators and the conditions under which they operate. Some rehabilitators are known to work with species prohibited by wildlife pet rules, such as bats. Others may rescue one litter of opossums, which are known to have a dozen or more young, causing the rehabilitator to exceed the number of individuals allowable under the wildlife pet regulation. Rehabilitation is a legitimate means of wildlife conservation if done by individuals experienced in the care of these animals, but the AGFC needs to exert oversight over this practice to make sure it is conducted properly.

- **Multiple state agencies have responsibility for endangered species in Arkansas.**

The AGFC is clearly the primary agency charged with the management of nongame and endangered wildlife in the state of Arkansas. However, there is overlap between the AGFC and the Arkansas Natural Heritage Commission in that both agencies are involved in tracking the status of rare and endangered species and habitats. Other agencies such as the Arkansas Department of Parks and Tourism manage lands used by endangered species. Clarification of the roles and responsibilities of Arkansas state agencies in the protection of endangered species is necessary in order to eliminate duplication of effort.

STRATEGIC NONGAME MAMMAL MANAGEMENT PLAN

Statement of Nongame Mammal Management Philosophy

The Arkansas Game and Fish Commission's nongame mammal management approach is to enhance habitat to maintain at least the current distribution of all nongame mammals and restore endangered species populations to levels that would allow removal from state and federal endangered species lists.

RESOURCE GOAL:

Maintain current distribution of non-endangered bats and restore populations of endangered bats to objective levels.

Objective A: Monitor bat population trends.

- Strategy 1. Continue monitoring of caves used by Indiana bats, Gray bats, and Ozark big-eared bats in accordance with their recovery plans.
- Strategy 2. Continue cave surveys to locate additional endangered species populations.
- Strategy 3. Conduct a status survey of non-endangered cave bat populations.
- Strategy 4. Investigate monitoring methods for non-cave bats (mistnetting, bat detectors, bat house use indices, etc.).

Objective B: Restore and maintain Ozark big-eared bat winter populations at or above 750 bats.

- Strategy 1. Maintain existing cave gate and alarm systems at Ozark big-eared bat caves.
- Strategy 2. Purchase or obtain conservation easements for Cave AR-60 (Cave codes have been used in this document to protect these sites from unnecessary visitation).
- Strategy 3. Provide physical protection of Caves AR-54 and AR-60.

- Strategy 4. Determine the importance of limited use Ozark big-eared bat caves and develop appropriate management strategies. Include these caves in regular monitoring efforts.

Objective C: Restore Indiana bat winter populations to at least 6,000 bats and document a stable or increasing population at all hibernacula used by more than 500 bats.

- Strategy 1. Maintain cave gate and sign at Cave AR-47 and obtain a conservation easement or agreement to permanently protect this site.
- Strategy 2. Work with the U.S. Forest Service to construct a cave gate at Cave AR-46.
- Strategy 3. Place closure signs at other Priority 2 hibernacula and monitor human visitation to these sites. Increase amount of protection if warranted.
- Strategy 4. Place and maintain winter closure signs at all other hibernacula.

Objective D. Restore gray bat winter population to 600,000 and summer maternity populations to at least 200,000 bats.

- Strategy 1. Maintain current gates and fences at primary hibernacula and increase protection level if warranted.
- Strategy 2. Purchase or obtain conservation easements or agreements to protect at least 3 maternity caves, 1 hibernaculum, and 5 transient/bachelor caves on private land.
- Strategy 3. Construct, modify, or replace fences or gates to restrict human access to at least 2 maternity caves, 2 hibernacula, and 2 transient/bachelor caves.
- Strategy 4. Assist the Arkansas Natural Heritage Commission in replacing the fence at Cave AR-9 and evaluate need to purchase additional land at this site.
- Strategy 5. Place and maintain closure signs at all gray bat caves on public lands and 75% of those on private lands.
- Strategy 6. Assess potential for disturbance at bachelor and transient gray bat roosts.

Objective E. Promote reforestation or use of artificial bat roosting structures in areas where loss of structural habitat components may limit bat populations.

- Strategy 1. Determine effective methods of bat house design and placement in Arkansas.
- Strategy 2. Encourage use of "rocket box" bat houses on commercial forests or other locations where densities of natural cavity trees of sufficient size are low.
- Strategy 3. Encourage incorporation of bat houses into Backyard Wildlife habitat projects and USDA programs such as Conservation Reserve Program and Wetland Reserve Program.
- Strategy 4. Promote restoration of bottomland hardwood forests used by the southeastern bat and Rafinesque's big-eared bat.
- Strategy 5. Work with private landowners and ADEQ to identify and protect abandoned/unused water wells in south Arkansas used by Rafinesque's big-eared bats or provide alternate artificial habitat.

RESEARCH GOAL

Expand our base of knowledge regarding the life history and ecology of Arkansas mammals, particularly that of endangered species or species thought to be or considered as species of special concern, and those with limited distributions in the state.

Objective A. Identify key nongame mammal resources.

- Strategy 1. Conduct research to determine the distribution and status of terrestrial nongame mammals for which few records exist.
- Strategy 2. Survey caves, mines, bridges, and other potential locations for use by endangered or rare bats.
- Strategy 3. Identify important bat foraging and watering sites near key roosts and develop procedures for protecting them.
- Strategy 4. Develop guidelines that will allow cavers to recognize important bat caves and work with organizations such as the Arkansas Cave

Research Association and the National Speleological Society to locate and protect these sites.

- Strategy 5. Survey likely Indiana bat summer habitat to determine presence of maternity colonies in Arkansas.
- Strategy 6. Identify regional bat species requirements for maternity and hibernation roosts (cave and non-cave).
- Strategy 7. Conduct research to better understand how, when, and why bats use, vacate, and switch roosts.
- Strategy 8. Identify and locate special habitats such as glades or rock rivers that may harbor unique small mammal communities.

Objective B. Describe, quantify, and monitor the effects of current habitat management practices on nongame mammals.

- Strategy 1. Describe and quantify the impacts of different forest management practices on nongame mammals.
- Strategy 2. Determine the usefulness of artificial roosting structures such as bat houses, simulated tree cavities, and artificial bark in mitigating for reduction of natural bat roosting habitat in commercial forests.
- Strategy 3. Develop and evaluate the effectiveness of regional guidelines for density, size, and nature of “wildlife trees” to be left in managed forest stands.
- Strategy 4. Study the relationship of forest management and other land-use changes on the environment of caves used by endangered bats.
- Strategy 5. Research the effects of prescribed burning on cave-dwelling bats, bat maternity roosts in cavity trees and ground-hibernating red bats.
- Strategy 6. Evaluate the effects of ecosystem restoration projects in the Interior Highlands on nongame mammals.

Objective C. Determine the effects of environmental contaminants on nongame mammals.

- Strategy 1. Determine effects of pesticides and herbicides on individuals and populations of bats in forests and agricultural areas.

- Strategy 2. Evaluate the threat to bat populations posed by oil pits.
- Strategy 3. Study the effects on terrestrial small mammals from aflatoxins from fungal infections of fescue grasses and encourage replacement of fescue with native grasses.

PUBLIC SUPPORT GOAL

Maintain and enhance public support of AGFC nongame mammal and endangered species programs.

Objective A. Increase the public’s awareness of, and interest in, bats and other nongame mammals.

- Strategy 1. Develop brochures containing information on nongame mammal species ecology and management that will be available in print and on the agency website.
- Strategy 2. Develop educational programs for animal control and public health officials and, where possible, produce them in collaboration with leading veterinarian and public health organizations and biologists with knowledge of these species.
- Strategy 3. Develop nongame mammal education workshops and distance learning programs for teachers, biologists, wildlife officers, and other specialized groups.
- Strategy 4. Develop audiovisual programs and educational materials to assist teachers and environmental educators to incorporate nongame mammals into standard school curricula.
- Strategy 5. Create bat educational trunks for use by AGFC regional informational and educational specialists.
- Strategy 6. Determine need for bilingual education materials.
- Strategy 7. Focus information and educational efforts in areas near important bat roosts.
- Strategy 8. Include cave, water well, and other nongame mammal management recommendations in future revisions of Wildlife Management for Arkansas Private Landowners.

- Strategy 9. Include nongame mammal materials in new AGFC nature centers and include a major exhibit on bats and cave ecology at the proposed Fort Smith nature center.

Objective B. Quantify the economic and social impacts of bats in Arkansas.

- Strategy 1. Conduct research to quantify the economic values of bats, with special emphasis on consumption of crop, garden, and forest pests, as well as on eco-tourism associated with bat-watching sites.
- Strategy 2. Conduct a statewide survey to document nuisance nongame mammal incident rates and costs.
- Strategy 3. Document verified bat rabies risks and prevention costs relative to other diseases.

ADMINISTRATIVE GOAL

Revise AGFC administrative practices and existing programs to provide maximum benefits to nongame mammals.

Objective A. Integrate nongame mammal management into existing programs on AGFC-owned Wildlife Management Areas.

- Strategy 1. Conduct surveys for nongame mammals on Wildlife Management Areas.
- Strategy 2. Provide assistance in the development of area plans to ensure that the needs of nongame mammals are being met.
- Strategy 3. Identify opportunities for nongame mammal management demonstration projects on Wildlife Management Areas (e.g., bat houses, small ponds, dead and down logs, cavity-tree retention, and canebrake restoration).
- Strategy 4. Conduct in-service training of biologists and managers on nongame mammal ecology and management.

Objective B. Review and revise AGFC regulations and policies in order to better address issues important to nongame mammal conservation.

- Strategy 1. Develop a nuisance bat policy for use in handling complaints by the public and develop a list of pest control operators and biologists trained in responsible bat management.
- Strategy 2. Revise regulations 18.01 and 18.09 to clarify when depredation permits are necessary to take nongame wildlife.
- Strategy 3. Revise AGFC violation forms used by law enforcement officers to identify species involved in nongame-related incidents.
- Strategy 4. Revise scientific collecting permit procedures and require that more specific information be provided in annual reports.
- Strategy 5. Provide copies of scientific collecting permit reports containing information on rare species to the Arkansas Natural Heritage Commission.
- Strategy 6. Develop a bat band database and require that banding information be reported by those with scientific collection permits.
- Strategy 7. Develop a program to license or register wildlife rehabilitators.
- Strategy 8. Evaluate the effects of current wildlife pet regulations on individuals and populations of nongame mammals.
- Strategy 9. In cooperation with the Arkansas Natural Heritage Commission, develop an Arkansas list of species of special concern that would be incorporated into the AGFC Code of Regulations.
- Strategy 10. Use existing state and federal wildlife programs such as the Wildlife Habitat Incentives Program to promote nongame mammal conservation and management.
- Strategy 11. Develop an AGFC response plan for dealing with pet mountain lions that escape or are intentionally released as well as nuisance complaints attributed to mountain lions.

Objective C. Increase AGFC law enforcement efforts in endangered bat protection.

- Strategy 1. Conduct inservice training sessions for AGFC wildlife officers and other natural resource enforcement personnel to increase their knowledge of bat ecology, applicable laws and regulations, and protection needs.

- Strategy 2. Incorporate visits to endangered bat caves into regular wildlife officer patrol schedules.
- Strategy 3. Closure signs at bat caves should be worded in such a way as to facilitate prosecution of violators.
- Strategy 4. Provide owners of bat caves with appropriate contact information so that they can quickly mobilize law enforcement support when trespassers are found in a closed area.

Objective D. Foster collaboration between researchers, land managers, educators, non-governmental organizations, and the general public.

- Strategy 1. Assist in the formation of, and participate in, an Arkansas Bat Team as a subgroup of the Southeastern Bat Diversity Network.
- Strategy 2. Sponsor yearly meetings of the Bat Team to discuss current bat-related issues.
- Strategy 3. Develop and maintain Bat Team web pages.
- Strategy 4. Participate in the Southeastern Bat Diversity Network, Colloquium on the Conservation of Mammals of the Southeastern United States, the North American Bat Management Plan, and individual endangered species recovery planning to address issues important to bats.
- Strategy 5. Develop a network of volunteer Cave Stewards to regularly patrol important bat caves to maintain management structures (gates, signs, and fences) and document damage caused by unauthorized visitors.

EVALUATION:

- Monitoring of endangered bat caves will be used to measure progress towards meeting the Resource Goal.
- Research should be used to evaluate issues related to nongame mammal management; the results will be used to revise management programs.
- Public surveys will be used to document public awareness and knowledge of nongame mammals and management programs.

PRIORITIES FOR OBJECTIVES OF THE NONGAME MAMMAL STRATEGIC MANAGEMENT PLAN.

Highest Priority

Resource Goal

- Objective B: Restore and maintain Ozark big-eared bat winter populations at or above 750 bats.
- Objective C: Restore Indiana bat hibernating populations to at least 6,000 bats and document a stable or increasing population at all Priority 2 hibernacula.
- Objective D: Restore gray bat winter populations to 600,000 and summer populations to at least 200,000 bats.
- Objective A: Monitor bat population trends.

Research Goal

- Objective A: Identify key nongame mammal resources.

Medium Priority

Research Goal

- Objective B: Describe, quantify, and monitor the effects of current forest management practices on nongame mammals.

Public Support Goal

- Objective A: Increase the public's awareness of, and interest in, bats and other nongame mammals.

Administrative Goal

- Objective A: Integrate nongame mammal management into existing programs on AGFC-owned Wildlife Management Areas.
- Objective B: Review and revise AGFC regulations and policies in order to better address issues important to nongame mammal conservation.
- Objective C: Increase AGFC law enforcement efforts in endangered bat protection.
- Objective D: Foster collaboration between researchers, land managers, educators, non-governmental organizations, and the general public.

Lower Priority

Resource Goal

- Objective E: Promote reforestation or use of artificial bat roosting structures in areas where loss of natural forest habitat may limit bat populations.

Research Goal

- Objective C: Determine the effects of environmental contaminants on nongame mammals.

Public Support

- Objective B: Quantify the economic and social impacts of bats in Arkansas.

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Appendix 1. Arkansas Nongame Mammal Species List.

Scientific Name	Common Name	State Rank	Global Rank	Federal Status
ORDER INSECTIVORA	INSECTIVORES			
FAMILY SORICIDAE	SHREWS			
<i>Sorex longirostris</i>	Southeastern shrew	S2?-INV	G5	
<i>Blarina carolinensis</i>	Southern short-tailed shrew	S4	G5	
<i>Blarina hylophaga</i>	Elliot's short-tailed shrew	S?	G5	
<i>Cryptotis parva</i>	Least shrew	S4	G5	
<i>Notisorex crawfordi</i>	Desert shrew	S1?-INV	G5	
FAMILY TALPIDAE	MOLES			
<i>Scalopus aquaticus</i>	Eastern mole	S4	G5	
ORDER CHIROPTERA	BATS			
FAMILY VESPERTILIONIDAE	VESPERTILIONID BATS			
<i>Myotis lucifugus</i>	Little brown bat	S3?	G5	
<i>Myotis austroriparius</i>	Southeastern bat	S2?-INV	G3G4	
<i>Myotis grisescens</i>	Gray bat	S2-INV	G3	Endangered
<i>Myotis septentrionalis</i>	Northern long-eared bat	S2-INV	G4	
<i>Myotis sodalis</i>	Indiana bat	S2-INV	G2	Endangered
<i>Myotis leibii</i>	Small-footed bat	S1-INV	G3	
<i>Lasionycteris noctivagans</i>	Silver-haired bat	S2?	G5	
<i>Pipistrellus subflavus</i>	Eastern pipistrelle	S4	G5	
<i>Eptesicus fuscus</i>	Big brown bat	S4	G5	
<i>Lasiurus borealis</i>	Red bat	S4	G5	
<i>Lasiurus seminolus</i>	Seminole bat	S1?	G5	
<i>Lasiurus cinereus</i>	Hoary bat	S3?	G5	
<i>Nycticeius humeralis</i>	Evening bat	S3?	G5	
<i>Corynorhinus townsendii ingens</i>	Ozark big-eared bat	S1-INV	G4T1	Endangered
<i>Corynorhinus rafinesquii</i>	Rafinesque's big-eared bat	S2-INV	G3G4	
FAMILY MOLOSSIDAE	MOLOSSID BATS			
<i>Tadarida brasiliensis</i>	Brazilian free-tailed bat	S3-INV	G5	
ORDER XENARTHA				
FAMILY DASYPODIDAE				
<i>Dasyopus novemcinctus</i>	Nine-banded armadillo	S4	G5	
ORDER RODENTIA	RODENTS			
FAMILY SCIURIDAE	SQUIRRELS			
<i>Tamias striatus</i>	Eastern chipmunk	S4	G5	
<i>Marmota monax</i>	Woodchuck	S4	G5	
<i>Glaucomys volans</i>	Southern flying squirrel	S4	G5	
FAMILY GEOMYIDAE	POCKET GOPHERS			
<i>Geomys breviceps</i>	Baird's pocket gopher	S?	G5	

Scientific Name	Common Name	State Rank	Global Rank	Federal Status
<i>Geomys bursarius ozarkensis</i>	Ozark pocket gopher			
FAMILY MURIDAE	RATS, MICE, VOLES			
<i>Oryzomys palustris</i>	Marsh rice rat	S4	G5	
<i>Reithrodontomys montanus</i>	Plains harvest mouse	S1?-INV	G5	
<i>Reithrodontomys humulis</i>	Eastern harvest mouse	S1?-INV	G5	
<i>Reithrodontomys megalotis</i>	Western harvest mouse	S3S4	G5	
<i>Reithrodontomys fulvescens</i>	Fulvous harvest mouse	S4	G5	
<i>Peromyscus maniculatus</i>	Deer mouse	S4	G5	
<i>Peromyscus leucopus</i>	White-footed mouse	S4	G5	
<i>Peromyscus gossypinus</i>	Cotton mouse	S4	G5	
<i>Peromyscus attwateri</i>	Texas mouse	S4	G5	
<i>Ochrotomys nuttalli</i>	Golden mouse	S4	G5	
<i>Sigmodon hispidus</i>	Hispid cotton rat	S4	G5	
<i>Neotoma floridana</i>	Eastern woodrat	S4	G5	
<i>Microtus ochrogaster</i>	Prairie vole	S4	G5	
<i>Microtus pinetorum</i>	Woodland vole	S4	G5	
<i>Synaptomys cooperi</i>	Southern bog lemming	S2S3	G5	
<i>Rattus rattus</i>	Black rat	SE	G5	
<i>Rattus norvegicus</i>	Norway rat	SE	G5	
<i>Mus musculus</i>	House mouse	SE	G5	
FAMILY ERETHIZONTIDAE	PORCUPINES			
<i>Erethizon dorsatum</i>	Common porcupine	SA	G5	
ORDER CARNIVORA	Carnivores			
FAMILY FELIDAE	Felids			
<i>Puma concolor</i>	Mountain lion	S1	G5	

State and Global Rank Codes (Arkansas Natural Heritage Commission):

- INV = Inventory Element; The Arkansas Natural Heritage Commission is currently conducting inventory work on these elements to determine their status in the state. These elements may include outstanding examples of Natural Communities, colonial nesting sites, outstanding scenic and geologic features as well as plants and animals which, according to current information, may be rare, peripheral, or may be of management concern.
- G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- G2 = Imperiled globally because of rarity (6-20 occurrences or few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 - 100.

- G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- T-RANKS= T subranks are given to global ranks when a subspecies, variety, or race is considered at the state level. The subrank is made up of a "T" plus a number or letter (1, 2, 3, 4, 5, H, U, X) with the same ranking rules as a full species.
- S1 = Extremely rare. Typically 5 or fewer estimated occurrences in the state, or only a few remaining individuals, may be especially vulnerable to extirpation.
- S2 = Very rare. Typically between 5 and 20 estimated occurrences or with many individuals in fewer occurrences, often susceptible to becoming extirpated.
- S3 = Rare to uncommon. Typically between 20 and 100 estimated occurrences, may have fewer occurrences but with large number of individuals in some populations, may be susceptible to large-scale disturbances.
- S4 = Common, apparently secure under present conditions. Typically 100 or more estimated occurrences, but may be fewer with many large populations, may be restricted to only a portion of the state, usually not susceptible to immediate threats.
- S5 = Demonstrably widespread, common, and secure in the state and essentially ineradicable under present conditions.
- SA = Accidental.
- SE = Exotic

General Ranking Notes

- ? = A question mark is used temporarily when there is some indecision regarding the rank assignment or when an element has not been ranked.

Appendix 2. Guidelines for Nongame Mammal Habitat Management

FOREST MANAGEMENT:

Forest management for nongame mammals should emphasize production and retention of snags and den trees of appropriate size for use by cavity nesting wildlife, downed logs for terrestrial small mammals, water sources, and habitat diversity. Specific recommendations are:

- Timber should not be cut within 75 yards of either side of streams in order to prevent erosion and provide a ready source of potential den trees.
- A minimum of 15% of each stand over 100 acres should be managed to achieve overmature condition. In hardwoods, 100 years is normally needed, while at least 70 years is needed in pines.
- Stands managed primarily for timber production should have a minimum of 6 snags (standing dead trees) or den trees (live trees with cavities) per acre. At least one snag or den tree should be > 20" dbh and 30' tall, with the remainder being > 10" dbh and >30' tall. There should be at least 3 downed trees greater than 10" dbh and > 30' long per forested acre.
- When the two-aged shelterwood harvest method is used in hardwood stands, at least 16 live trees/acre and all snags, shagbark hickories, hollow trees, and trees with large dead limbs should be retained.
- Stands managed primarily for wildlife should contain at least 10 snag or den trees per acre consisting of: 1 snag and 1 den tree > 20" dbh and 30' height, 2 snags or den trees ranging from 10-20" dbh, and at least 2 snags and 2 den trees ranging from 6-10" dbh. There should be at least 6 downed trees greater than 10" dbh and > 30' long per acre.
- Hardwood tree species proving most valuable as potential roost sites for forest bats are: shagbark hickory, silver maple, shellbark hickory, green ash, white ash, beech, eastern cottonwood, red oak, post oak, white oak, slippery elm, American elm, sugar maple, shingle oak, and sassafras. When possible, snags or den trees retained after harvest should be from this list.

- Natural cavity production should be encouraged, but in younger stands snags and cavities in den trees can be created with these methods if an inventory of snag/den trees shows that the size class distribution and densities do not meet recommended guidelines:
 - Killing selected live trees using stem injection of herbicide or fungus (Do not kill existing den trees). Though girdling trees works, snags created with this method do not stand long enough to maximize wildlife use.
 - Cutting a limb (the larger and higher the better) about 6" from the trunk of the tree. This works well in ash, elm, cottonwood, red maple, and sycamore.
 - Chop a section of bark from high in a tree, preferably one that already shows damage or decay.
 - Drill a hole, at least 2" in diameter and 3" deep into the trunk of a tree. Preferably this would be under a high limb that is 3" or more in diameter.

- Structures such as flying squirrel nest boxes and bat houses (rocket box design) may be a suitable management strategy in areas where natural cavities are very limited. Bat houses should be placed on poles > 12' tall in or adjacent to wildlife openings, food plots, or at wildlife ponds where the box will receive at least 7 hours of direct sunlight each day.

- Forests should have at least 4 permanent surface water sources per square mile. Very small ponds, with diameters of only 10', may provide adequate water at critical times for bats, terrestrial small mammals, and some reptiles and amphibians. Ponds should be as deep as possible depending on soil substrate and should have gently sloping sides to ensure access as water levels drop during dry periods. These small ponds may be placed next to wildlife openings or food plots.

- Efforts at restoring pine forests for red-cockaded woodpeckers do not seem to have an adverse effect on the Indiana bat, and may even help provide additional roost trees. Terrestrial small mammals also respond favorably to these efforts.

- Where possible, bottomland hardwood forests should be restored and existing stands retained, especially areas with large, older growth timber. Tupelo and other tree species in these habitats are often used as roost sites by the rare Rafinesque's big-eared bat and southeastern bat.

CAVE/MINE MANAGEMENT:

Caves and mines are a valuable habitat component for many species of Arkansas bats. Management practices should focus on avoiding human visitation to caves during periods they are occupied by bats.

- Caves and mines used by hibernating bats should not be visited from August 15 - May 15. Research has shown that bats can be disturbed even when visitors quietly move through a cave without directly contacting the bats. Disturbance during this period may cause bats to use valuable fat reserves and they may not survive until spring.
- Caves and mines used by bats during the summer should not be visited from March 15 - August 15 to reduce disturbance to maternity colonies.
- Bat-friendly gates or fences will help reduce unwanted visitation to bat caves and mines. Federal programs such as the Partners for Fish and Wildlife Program (U.S. Fish and Wildlife Service) and Wildlife Habitat Incentives Program (Natural Resource Conservation Service) may provide funds for building these structures on private lands.
- Managers should avoid cutting timber within 150' of caves and mines used by bats to avoid alteration of the microclimate inside the cave. It may be appropriate to cut brush from entrances that are becoming overgrown. At caves used by endangered or rare bats, this buffer zone should extend to ¼ mile. Forest management within 1.5 miles of Indiana bat caves should focus on maximizing snag retention. Timber harvest and/or maintenance in buffer zones should not occur during the period caves are occupied by endangered bats.
- Caves used by bats should be considered smoke-sensitive areas when conducting prescribed burns. When possible, prescribed burning should be conducted when the caves are not being used by bats.
- On public land, roads and trails should not be built within ½ mile of caves and mines used by endangered or rare bats. Existing roads and trails should be rerouted or closed in order to reduce visitation to these sites.
- Caves and mines used by endangered or rare bats on public lands should not be mentioned in visitor guides, maps, or other publications in order to reduce potential disturbance. Locations should be removed from existing publications as soon as possible. Managers should only provide this information to qualified scientific researchers or others with a valid reason to visit these sites and all visits should be documented.

- Bat surveys should be conducted seasonally for 1 year before closing or blocking mine entrances. Closure of mine entrances for safety reasons should employ bat-friendly gates where possible. These mines may become important to bats and other animals at some future date.

FARMLAND MANAGEMENT:

Bats are predators of important agricultural pest insects. An average colony of big brown bats (150 individuals) will eat as many as 600,000 cucumber beetles, 194,000 scarabaeids, 158,000 leafhoppers, and 335,000 stinkbugs each year. Just one of these pest species, the larval form of the cucumber beetle (known as the corn rootworm), costs U.S. farmers one billion dollars each year. Farmers should be encouraged to develop bat habitat on their land as part of an integrated pest management strategy.

- Where appropriate, Forest and Cave/Mine Management strategies described above should be implemented on farmlands.
- Retention of trees along field borders and on unproductive land will provide valuable bat roosting habitat in snags and den trees. Buffer strips of at least 75 yards should be retained or restored adjacent to streams. In small woodlots (<10 acres), plots of at least 1 acre should be set aside and managed to maximize snag and den tree potential (See forest management guidelines).
- Rowcrop farmers should erect at least 1 group of 3-5 pole-mounted bat houses for every 320 acres in production. Bat houses should be placed in areas that will not be affected by aerial spraying of pesticides or herbicides.
- Abandoned houses or outbuildings used by bats should be stabilized to prevent collapse. In the southern portion of the state, old wells should be retained and capped in such a way that bats can enter the well to use it as a roost site. In structures where collapse is imminent or if exclusion from human-occupied buildings is necessary, bat houses should be placed near the original building.
- Fescue should be eradicated and replaced with native grasses wherever possible.