

Status and Management of Endangered Bats in Kentucky

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Abstract: Three species of bats are endangered in Kentucky: the Indiana bat (*Myotis sodalis*), the gray bat (*M. grisescens*), and the Virginia big-eared bat (*Corynorhinus townsendii virginianus*). Because some level of monitoring of these bats has taken place at Kentucky caves for several decades, trends can be assessed and some effects of management practices can be evaluated. In Kentucky, populations of Indiana bats continue to decline despite numerous protection efforts, populations of gray bats appear stable, and populations of Virginia big-eared bats are increasing.

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Kentucky is within the range of 3 species of bats that are listed by the U.S. Fish and Wildlife Service as endangered: the Indiana bat, the gray bat, and the Virginia big-eared bat. Reasons contributing to their endangered status include human disturbance, vandalism, manmade modifications of caves, flooding, and pesticides. Monitoring populations of these species allows trends to be determined and aids in making management decisions. This paper summarizes data on populations of endangered bats in Kentucky and discusses related management efforts.

All of Kentucky's listed bats use caves during winter for hibernation. In summer, maternity and bachelor colonies of gray and Virginia big-eared bats also occupy caves, whereas Indiana bats use trees. Sites of occurrence of Indiana bats are scattered throughout Kentucky, with the largest populations using hibernacula located in eastern Kentucky within the Cumberland Plateau Physiographic Region. Gray bats also are found throughout the state with major hibernacula and maternity colonies in the Pennyrile Physiographic Region and a few maternity caves in the Bluegrass Physiographic Region. Virginia big-eared bats are found only in 9 eastern Kentucky counties of the Cumberland Plateau with the majority of the population occurring in 1 county.

The Kentucky Department of Fish and Wildlife Resources (KDFWR), the U.S. Forest Service (USFS), the Kentucky State Nature Preserves Commission (KSNPC), and the U.S. Fish and Wildlife Service (USFWS) regularly monitor endangered bats in Kentucky. These agencies and other cooperators have worked to protect caves in Kentucky through acquisition of land, gating and fencing, use of interpretive/warning signs, development of cooperative agreements, or other means. Other cooperators involved in monitoring and protection efforts include The Indiana Bat Recovery

Team, Bat Conservation International, Mammoth Cave National Park (MCNP), Kentucky Department of Parks, The Nature Conservancy, U.S. Army Corps of Engineers, Natural Resource Conservation Service, American Cave Conservation Association, National Speleological Society, local grottoes, many individual volunteers, biological consultants, and private landowners. Monitoring and protection efforts by KDFWR primarily are paid with funds administered by the USFWS under Section 6 of the Endangered Species Act.

Methods

Censuses of Hibernacula

Kentucky has >100 caves that serve as hibernacula for Indiana bats. Priority 1 and 2 Indiana bat hibernacula are monitored every 2 years as recommended by the USFWS (Brady et al. 1983, USFWS 1999). Priority 1 Indiana bat hibernacula ($N=3$) are those with a population of >30,000 bats since 1960 and Priority 2 hibernacula ($N=15$) are those that have had populations >500 and <30,000 (USFWS 1999). Priority 1 hibernacula ($N = 2$) for gray bats are also monitored biennially. Priority 1 designation for gray bats in Kentucky is given to those caves having winter populations of $\geq 25,000$ bats (Brady et al. 1982). More than 99% of Kentucky's Virginia big-eared bat population hibernates in 1 hibernaculum which also is monitored every 2 years (Bagley 1984).

No specialized equipment is necessary to count bats at their hibernacula. Wheat lamps and dive lights generally are used to illuminate bats and occasionally, binoculars or spotting scopes are used to help count bats on high ceilings. Bats roosting individually or in small clusters (<50 bats) are counted directly. For bats roosting in large clusters (>50 bats), the surface area they occupy is measured and the approximate density of bats is determined. Multiplying the surface area occupied by the density of the bats gives an estimate of cluster size. This method expedites data collection in an effort to minimize disturbance to hibernating bats. Censuses at hibernacula include all species of bats encountered. Censuses are ideally conducted during mid-January to mid-February.

Summer Censuses

Non-intrusive methods are preferred for conducting censuses at summer roosts, particularly maternity colonies (Bagley 1984). Wheat lights with infrared filters (Kodak Wratten Gelatin Filter No. 87, Eastman Kodak Co., Rochester, N.Y.) are placed to illuminate cave openings. The MK-426 night-vision scope or the MK-880 night-vision pocket scope (both Star-Tron Tech. Corp, Pittsburgh, Pa.) is used to count bats as they emerge from the cave. Bagley (1984) recommended that emergence counts at maternity sites be scheduled before young are volant but late enough in the maternity season to count maximum number of females. From 1996–2001, KDFWR usually conducted emergence counts for gray bats during the first 2 weeks of June. Censuses of Virginia big-eared bats and gray bats prior to 1995 occurred at various times during the season.

Although there are now Indiana bat maternity records scattered throughout Kentucky, regular monitoring of populations is not practical due to the ephemeral nature of maternity roosts of Indiana bats (Humphrey et al. 1977). Because there are currently >20 summer sites with gray bats, significant caves are now on a 2-year census cycle. The 5 summer sites for Virginia big-eared bats are surveyed on an annual or biennial basis.

Results and Discussion

Censuses of Hibernacula

Indiana bats.—Three caves (Bat, Coach, and Dixon) in Kentucky are designated as Priority 1 hibernacula for Indiana bats. Both Bat and Coach caves historically had an estimated 100,000 bats, which dramatically declined in the 1960s and early 1970s (Fig. 1). Modifications to entrances of these caves during this time caused the microclimate to change, thus making the caves less suitable as hibernacula for Indiana bats.

By 1975, the population in Bat Cave had declined to about 40,000 bats. Improperly designed entrance structures installed in early 1970s intended to keep people out were removed in 1983, when Bat Cave, which is located on Carter Caves State Resort Park (CCSRP), had Kentucky's first bat-friendly cave gates installed. The population seemed to respond to this by increasing in the late 1980s (Fig. 1). For unknown reasons, the population in Bat Cave started to decline in 1993 (Fig 1). Flooding killed an estimated 3,000 Indiana bats at the cave in 1997 when the upper gate was washed out. Flooding threatened the bats again in 2000. Consequently, both of the original

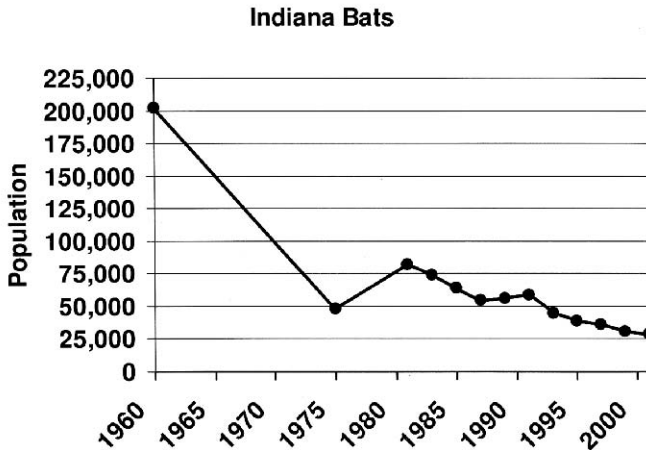


Figure 1. Population estimates of Indiana bats at Priority 1 hibernacula in Kentucky.

angle-iron gates have been replaced with more structurally sound gates that should decrease the chance of flooding. Bat Cave currently harbors the largest concentration (about 25,000) of Indiana bats in Kentucky. One possible reason for the continued decline at Bat Cave is that temperatures are not ideal throughout winter and because Saltpeter Cave (also CCRSP), may have been the original hibernaculum for the population of Indiana bats currently using Bat Cave (Tuttle and Kennedy 1999).

Due to commercialization, the main entrance of Coach Cave was blocked in 1960s with a concrete wall and a steel door with small openings for bats to exit. In addition, a gift shop was built over the upper entrance, and a third entrance was blasted into the cave. By 1975, the population of bats had decreased to 4,500 bats. It was not until 1993, when the population was down to 27 bats, that negotiations were made with the private landowner to install bat-friendly cave gates. From 1993 to 1999, the average number of Indiana bats occupying the cave was only 30. M. D. Tuttle (Bat Conserv. Internatl. pers. commun.) recommended construction of a "cold-air dam" to make the microclimate of the cave even more suitable for Indiana bats. A cold-air dam, which reduces the amount of cold air escaping from the cave, was completed in January 1999, and by January 2001, the population of Indiana bats had increased to 101.

Dixon Cave (MCNP) is the third Kentucky cave designated in the Indiana Bat Recovery Plan as a Priority 1 Indiana bat hibernacula. In the early 1980s, its population was originally estimated at 30,000, which represents the third largest hibernating populations of Indiana bats in a Kentucky cave since 1960. By 1987, it held approximately 16,550 bats. Though the cave is protected by both an angle iron gate and a fence, its population continues to decline, reaching a low of 3,670 bats during the 2001 census. In Kentucky, >20 hibernacula of Indiana bats are gated, but the overall population continues to decline.

Gray bats.—Until as recently as 1999, there has been only 1 major hibernaculum of gray bats in Kentucky, Jesse James Cave, which has harbored 100,000 to 300,000 bats each winter. The only other notable hibernaculum was Dixon Dave, which held a high of 975 gray bats in 1995. Caves in western Kentucky caves only have a few scattered winter records of ≤ 12 gray bats. Population estimates for Kentucky actually are higher in winter than in summer (Fig. 2). Gray bats have been documented migrating from adjacent states to hibernate in Kentucky (Hall and Wilson 1966) and recent banding efforts in Tennessee confirm this to still be true (A. Henry, BHE Environ., Inc., pers. commun.).

In 1999, about 71,000 gray bats occupied Coach Cave. This population was assumed to have originated from Jesse James Cave which is located only a few hundred yards away from Coach Cave. During the same census period, the population at Jesse James Cave was estimated at 154,500 bats. The major hibernaculum of gray bats in Arkansas experienced a similar decrease based on movement to other caves (Harvey 1996). In 2001, about 105,000 gray bats were in Coach Cave. Restoration efforts at Coach Cave to restore it as a cave for Indiana bats (see previous) evidently had improved microclimate for gray bats.

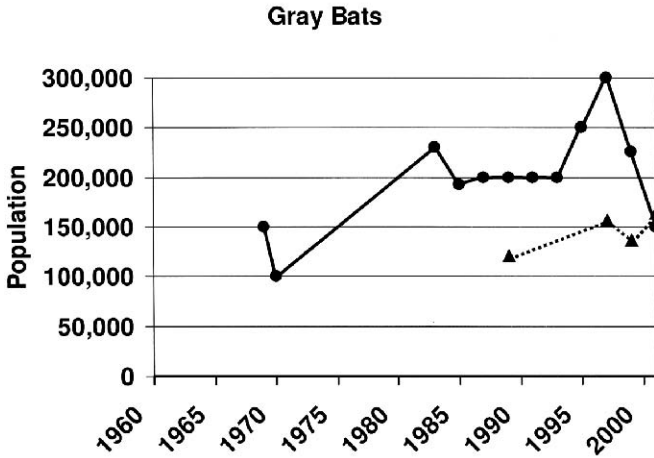


Figure 2. Population estimates of gray bats in Kentucky. (closed circle = Winter; closed triangle = Summer)

Jesse James Cave, located on the same private property as Coach Cave, also was commercialized in the 1960s, and although size of historic populations is unknown for this cave, one can assume that improper entrance structures had a devastating effect on populations of bats here too. As with Coach Cave, the landowner agreed to allow bat-friendly cave gates to be installed in 1993. Looking at the data for Priority 1 hibernacula of gray bats, (assuming Coach Cave would now be designated as Priority 1 for gray bats too), Kentucky's population has had an upward trend since the 1970s when commercial tours at Jesse James Cave were decreased. The population also showed a marked rise for 2 census periods after proper gating (Fig. 2).

Estimating size of winter populations of gray bats is difficult. During the study period, roosting areas in Jesse James Cave are convoluted, and bats are distributed at varying densities, making size of populations difficult to ascertain. Gray bats roosting in Coach Cave are more uniformly distributed on lower, relatively flat ceilings, which allowed for more accurate estimates; therefore, the initial decrease from 1997 to 1999 (Fig. 2) may be observer error. In 2001, >30,000 additional gray bats moved into Coach Cave, and the overall population seemed to suffer another major decline.

Virginia big-eared bats.—The population of Virginia big-eared bats continues to increase at Stillhouse Cave (Fig. 3), the only major hibernaculum for species in the state. The cave, acquired by DBNF in 1998, was gated in 1993 and the access road was closed. The count for 2001 (6,335 bats) was an increase of >500% since these protective measures were put into place. More than 30 caves in Kentucky have Virginia big-eared bats during winter, but each with ≤ 15 individuals.

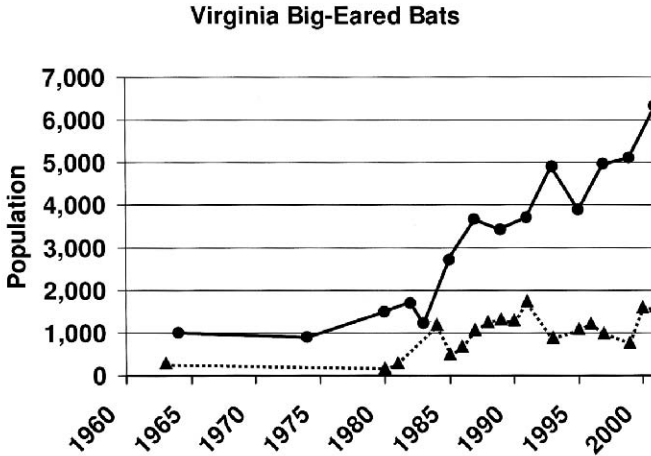


Figure 3. Population estimates for Virginia big-eared bats in Kentucky. (closed circle = Winter; closed triangle = Summer)

Summer Censuses

Gray bats.—Prior to the work of Rabinowitz and Tuttle (1980), no thorough research had been conducted to establish distribution in summer and size of populations of gray bats in Kentucky. The next intensive survey effort was in 1989 by KDFWR. Rabinowitz and Tuttle (1980) estimated populations based on measurements of piles of guano; KDFWR estimated size of populations based on emergence counts. Because KDFWR continues to use emergence counts, the summer counts of gray bats in 1989 were selected as a baseline to evaluate population trends (Fig. 2).

Because only half of summer sites for gray bats are surveyed each year, adding estimates for every 2 years represents the best available estimate of the total population of gray bats. Interpretation of census data for gray bats and comparison with previous censuses is difficult. Variation among observers, possible movement between caves, and normal population fluctuations might explain some differences. Based on the best available data, the summer population of gray bats in Kentucky appears to be increasing (Fig. 2).

It is difficult to protect caves that contain gray bats in summer, because most are on private land and gating is not yet feasible for maternity colonies. Fencing is not always adequate or practical, and signs at several caves are repeatedly taken down by people or flood waters.

Virginia big-eared bats.—The 5 caves used as summer sites are all in DBNF. Summer populations for the species currently account for <25% of the population in winter (Fig. 3). Because Virginia big-eared bats are known to be a rather sedentary species (Barbour and Davis 1969), it is believed that more summer colonies must

exist in Kentucky. Based on the best available data, the population of Virginia big-eared bats in Kentucky seems to be stable to increasing (Fig 3). The data is not without some bias: the 5 sites were not all monitored regularly until 1995, and the late timing of some surveys may have showed increases in populations because of volant young or decreases in populations because of early colony dispersal. Because there are only a few colonies in summer, efforts have been made in recent years to conduct the surveys on the same night or as close as possible because populations may shift between caves. Ideally, future summer censuses should be conducted about the third week in June.

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