PROTECTING CAVE BAT POPULATIONS WITH FLYOVER BARRIERS

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Abstract

Prevention of human disturbance to bats roosting in caves and mines is a primary management goal for cave bat populations. Angle-iron bat gates placed across cave passages have become the standard method of controlling unauthorized visitor access to these sites. However, these structures may not always be appropriate due to the physical dimensions of the passageway, construction costs, or the bat species using the cave. Flyover barriers are an alternative method of protecting bat caves that include chain link fences with barbed wire outriggers, vertical steel bar fences, and half gates. A mail survey of bat cave surveyors and managers was conducted in 2001 to determine the construction costs, maintenance needs, and effectiveness of flyover barriers in reducing human entry into the caves and in bat population recovery. Twenty-six chain link fences, seven vertical steel bar fences, and seven half gates have been used at 37 caves in nine States. Chain link fences were inexpensive to build but required more routine maintenance than vertical steel bar fences. The cost of half gates is also high, but is the only suitable option when a flyover barrier must be placed inside the cave. All three designs reduced disturbance and bat populations increased at caves where they had been placed.

Introduction

Several bat species that live in caves and mines have suffered population declines over the last 30 years. Often, this is due in part to both intentional and unintentional harm caused by humans entering these sites during periods when they are inhabited by bats (Pierson 1999). Efforts to restore populations of endangered species such as the Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) have focused on preventing human access to caves. A standard bat gate design consisting of horizontal angle-iron bars with 5 ¾" of space between bars has been developed that is greatly resistant to forcible entry by humans, causes minimal changes to cave microclimate, and allows bats to freely enter and exit these caves (White and Seginak 1987; Nieland 2001).

Standard bat gates provide the greatest degree of protection to caves, but may not be appropriate for use at some sites. Large horizontal entrances may require bat gates of such height or width that costs become prohibitive while gates placed at caves with entrances less than 5' in diameter may restrict airflow to such an extent that the internal microclimate of the cave is altered (Tuttle 1977). Bat gates can be adapted for use as cupolas over small vertical cave entrances or mineshafts, but may not be practical when the entrance is over 20' in width (Tuttle and Taylor 1998; Nieland 2001).

Certain species, such as the gray bat, Brazilian free-tailed bat (*Tadarida brasiliensis*), and Lesser long-nosed bats (*Leptonycteris curasoae*) may not fully accept standard bat gates that cover the entire passageway or entrance to a cave (White and Seginak 1987; Burghardt 2000, Currie 2000). At Blackwell Cave, Missouri, a gray bat summer colony abandoned the cave after a bat gate (round bar design) was built at the entrance, but returned after this gate was replaced with a flyover barrier (R.L. Clawson, Missouri Department of Conservation, Columbia, Missouri, personal communication, 2002). Placement of the standard bat gate in the dark zone of the cave, 10-56' from the entrance, has proven successful at gray bat summer caves in Oklahoma; however, at Colliers Cave, Alabama gray bats abandoned the portions of the cave behind an internal gate and populations declined until the gate was removed (Martin et al. 2000; Henry 1998). Another attempt to use this technique at Logan Cave, Arkansas, produced mixed results; emergence counts declined by about 50 percent in the three summers after an internal bat gate was built, but population estimates based on the size of guano piles in the cave have almost doubled (Harvey and Redman 2001; S.L. Hensley, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, personal communication, 2002).

When it is not feasible or appropriate to install a standard bat gate, flyover barriers may be used as an alternative method of preventing unauthorized human access to caves. As the name implies, flyover barriers allow bats to enter or exit the cave by flying over the barrier that keeps humans out. Flyover barriers include chain link fences with barbed wire outriggers or vertical steel bar fences placed at or around cave entrances, and half gates placed inside cave passageways. Half gates are standard bat gates that block only the lower portion of a passageway, and allow bats to fly between the structure top and the ceiling (Nieland 2001).

Flyover Barrier Survey

A mail survey was sent to bat biologists and to State and Federal natural resource agencies in late 2001 to obtain information on sites protected by flyover barriers. Respondents were asked to describe the type of barrier used, construction costs, changes in patterns of unauthorized entry, and bat population response after barrier construction. Surveys were returned for barriers at 37 caves in nine States. Chain link fences have been used at 26 caves in Alabama, Arkansas, Indiana, Kentucky, Maryland, Missouri, Nevada, Tennessee, and West Virginia. Vertical steel bar fences are found at seven caves in Arkansas and half gates are in use at seven caves (three of these replaced chain link fences also included above) in Missouri. Recommendations for flyover barrier use are based on survey responses.

General Fence Considerations

Prior to the construction of chain link or vertical steel bar fences, observations should be made to determine the normal flight path used by bats so that the planned barrier will not obstruct these routes. Fences around vertical entrances should be set back from the cave a distance equal to at least twice the height of the fence. As bats cannot easily pass through fences, these designs should generally not be used inside horizontal cave entrances and if a flyover barrier is necessary inside a cave, a half gate is much more desirable. Natural topography and vegetation should be used as a screen between the fence and areas used by the public in order to lower barrier visibility. Painting the fence to blend in with the site will also help avoid attracting undue attention to the cave. Vertical steel bar fences are more resistant to damage than chain link fences and should be used in remote areas where routine patrols are not feasible.

Chain Link Fences

Chain link fences provide the most inexpensive means to physically protect bat caves from human disturbance. Recently constructed fences in Kentucky and Nevada cost $15 and $17.50/linear foot while Ludlow and Gore (2000) reported a cost of $10/linear foot at a Florida cave. Fences should be at least 8-12' in height with an additional 1-2' of outward-facing barbed wire outriggers on the top. Though fences less than 8' in height or without barbed wire outriggers may prevent accidental entry into vertical shafts or sinkholes, they do not present a significant impediment to intentional cave entry and should not be used when bat protection is desired. The base of the fence should be set 6" below the surface in order to prevent people from crawling or digging underneath. Posts should be set in concrete, but doing so to the entire base of the fence may make repairs difficult (Tuttle 1977). If digging underneath the fence is a continuing problem, steel rods, at least 6" long, can be driven into the bottom of a shallow trench in front of the fence and then the trench filled with concrete. Additional hindrances to those trying to climb over these fences may include the addition of an inward-facing barbed wire outrigger, placing coiled barbed wire (e.g., concertina wire) at the base, or using a smaller chain link mesh size.

Managers of sites using chain link fences may expect 0-2 damage incidents each year due to vandalism and natural hazards. An inspection should be made and any required repairs performed prior to the arrival of bats at the cave. Regular patrols are necessary throughout the period of bat use in order to quickly find and repair any additional damage. The most common problems are usually falling trees or limbs destroying a fence section and vandals cutting holes in the chain link or barbed wire. One incident was reported in which the entire fence at Key Cave, Alabama, was stolen.

Nickajack Cave, Tennessee, is a unique site because the cave entrance is level with the surface of a reservoir. The chain link fence extends over both land and water and boaters often cut a hole in the fence so they could float into the cave. To combat this unusual form of vandalism a cable with floatation booms was placed approximately 30 yards in front of the fence and has prevented most boaters from attempting to access the site.

Survey respondents reported only two bat mortalities related to 20 chain link fences that had been in place a combined total of 311 years. One bat died after having its wing snagged by barbed wire and another was found tangled in the chain linking. In order to prevent such deaths, barbless wire was used atop the chain link fence at Coffin Cave, Missouri (LaVal and LaVal 1980). There were no mortalities reported for six other fences but incomplete survey responses make it impossible to state how long they have been, or were, in use. While any endangered species death is important, proper fence placement can reduce such accidental mortality while also eliminating the problem of predation experienced at standard bat gates (Tuttle 1977, White and Seginak 1987).

Chain link fencing is an effective conservation technique and has generally been successful at protecting bat caves. Human disturbance decreased at 92% and remained unchanged at 8% of caves (N = 24) with these barriers. Bat populations increased at 81%, remained unchanged at 10%, and decreased at 10% of caves following installation of chain link fences (N = 21). There was insufficient information to evaluate human disturbance at two caves and bat populations at five caves. Of the two caves where bat colonies declined, one has an extraordinary amount of fence vandalism (approximately six incidents/year) and the second is used by the Indiana bat, a species that has continued to decline in spite of intensive cave protection efforts (Clawson 2000). Although not included in this study, chain link fences at five Florida caves successfully protect southeastern bat (*Myotis austroriparius*) and gray bat colonies and have proved less disruptive to bat emergence patterns than bat gates (Gore and Hovis 1994; Ludlow and Gore 2000).

Vertical Steel Bar Fences

Vertical steel bar fences were used at seven caves and have proven sturdier, though more expensive ($125-200/linear foot), than chain link fences. The current design calls for 1" thick steel bars spaced 6" apart (on-center), extending 10.5' above the surface, and with the top 1' 10" bent outwards at a 45° angle. The fence base should be within 4" of bedrock or be placed on a concrete footing 6" deep with 1" steel rods extending to bedrock or 6" below the base of the footing.

There has been one bat death associated with vertical steel bar fences. The fence at Bone Cave, Arkansas, extends in a "U" shape in front of the cave with the ends of the "U" inside the cave entrance. Soon after it was built a sunset emergence count was conducted at this gray bat maternity cave and approximately 60 (0.4%) of a colony of 14,870 bats attempted to fly back into the cave at a point where the fence intersects the inside wall of the cave. Twenty of these bats went through the fence without stopping and 20 turned around and flew away. However, the observer heard 20 bats apparently hit the fence while passing through it. After the count was complete, one dead bat was found on the ground underneath the fence. That portion of the fence was quickly modified so bars are horizontal and spaced 5 ¾" apart in order to prevent additional deaths. The top of the fence contacts the cave ceiling and prevents anyone from climbing over the top of this section of the fence. No further mortality has been noted since this change was made. This incident highlights the need to understand bat flight paths and incorporate this information into cave management planning prior to construction.

The National Park Service constructed vertical steel fences instead of standard cave gates at five gray bat caves on the Buffalo National River, Arkansas in 1982-1983. This option was chosen in order to avoid restricting bat movements, eliminate the risk of predation at a bat gate, and to avoid changing airflow patterns within the cave (Fletcher 1985). Four of these caves are transient or bachelor roosts and it has been difficult to evaluate the success of these efforts due to the unpredictable patterns of bat use at these locations. The other site, Cave Mountain Cave, has experienced a meteoric increase from 50 hibernating gray bats before construction to 234,850 in 2001-02 (Harvey 1996; M.J. Harvey, Tennessee Technological University, Cookeville, Tennessee, personal communication, 2002). However, it is possible for people to bend the bars and climb over or through the 9'3" tall, ¾" thick bars used in these earlier fences. Two other fences, built with the improved design at gray bat maternity colonies by the Arkansas Game and Fish Commission in 2001 and 2002, have not been in place long enough to assess levels of effectiveness.

Half Gates

Half gates use the standard bat gate design (Nieland 2001) but are topped by a horizontal 48" expanded-metal ledge or slanted outrigger bars to prevent people from climbing between the gate and the cave ceiling. These barriers are at least 9' tall and leave a space greater than 4' between the top of the gate and the cave ceiling and should only be used in passages that are in excess of 13' in height. Five of seven half gates reported from Missouri use this design while the other two, built in 1980 and 1985, use round metal bars instead of 4" angle iron. Ladders or tree limbs can be used to climb over short structures, and if possible, half gates should exceed 18' in height. Graphite grease can be spread over the expanded-metal ledge or outrigger bars to discourage human contact with that portion of the half gate. Due to their similarity to the standard bat gate, design and construction guidelines can be found elsewhere in this volume and in Nieland (2001). Prices are comparable with standard gates; three half gates built in Missouri since 1996 cost $30-42/square foot.

Unauthorized human entry declined at six caves with half gates and bat populations increased at all seven caves. There was insufficient information to assess changes in human disturbance at one cave. Colonies protected with round bar half gates did increase in size, but the local bat surveyor recommends replacing them with the current design. White and Seginak (1987) reported that at Blowing Wind Cave, Alabama (not included in this survey), most of the gray bat maternity colony used an entrance blocked with a half gate rather than a passage with a standard bat gate. Presently 87 percent of this very large colony continue this pattern though approximately 30,000 bats use the standard bat gate (Keith Hudson, Alabama Department of Conservation and Natural Resources, Florence, Alabama, personal communication, 2002).

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