# Final Report

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# USE OF BRIDGES BY ROOSTING BATS


## Summary

From May through July 2001, and June through August 2002 we surveyed a total of 232 bridges in 9 southern Illinois counties for the presence of roosting bats. A total of 15 bridges (approximately 6.5% of the 232 bridges) had roosting bats at the time they were surveyed. Big brown bats (*Eptesicus fuscus*) were encountered most frequently. Eastern pipestrelles (*Pipestrellus subflavus*), little bown bats (*Myotis lucifugus*), and northern long-eared bats (*M. septentrionalis*) also were found roosting under bridges. The number of bats per bridge ranged from 1 to >100. Bats occurred in four of the five types of bridge designs surveyed. Of the 15 bridges with bats, 11 were rechecked at a later date to determine continuity of use and to calculate a "correction factor." Seven of the 11 (63.6%) were being used by bats when rechecked. From this, we suggest an actual usage rate of 23.6 bridges (15 ÷ 0.636) during the study, or about 10% of the 232 bridges surveyed. No relationships were apparent between bat presence and habitat features around bridges.


## INTRODUCTION

Bats are an important group of mammals both to the general public and management agencies. Four species of bats in Illinois are state or federally endangered: Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*), southeastern bat (*Myotis austroriparius*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Knowledge of life history characteristics of listed species, as well as the other 8 species of bats that occur in Illinois, is critical for population assessment and effective management. One such life history characteristic is the type of sites used for day and night roosting. Bats in temperate regions roost in numerous types of natural and artificial structures (Kunz and Pierson

1994). However, lack of suitable roost sites may be a critical limiting factor in the abundance, distribution, and dynamics of bat populations (Lewis 1995, Fenton 1997). In addition to caves and tree snags, the underside of certain types of bridges are used by bats for roost sites, especially bridges with alcoves or open expansion joints (Davis and Cockrum 1963, Adam and Hayes 2000). Conversely, bats do not use flat-bottomed (slab) bridges, possibly because the microclimate is unsuitable. The extent of bridge use by bats, types of bridges that may be used, and discernable patterns to the surrounding habitat are questions that have not been addressed in Illinois. We initiated this study to investigate the use of bridges as roost sites by bats in southern Illinois.

## MATERIALS AND METHODS

We surveyed 232 bridges in 9 southern Illinois counties: Franklin, Jackson, Johnson, Perry, Pope, Pulaski, Saline, Union, and Williamson (Table 1). Only bridges that were maintained by the state or a county were surveyed. Generally, these were ≥ 20 m long. Smaller bridges, often those over pipe culverts maintained by townships, were not investigated. They often were inaccessible and were deemed inappropriate for the current study. Bridge designs surveyed included: parallel box beam, prestressed girder, cast-in-place, I-beam, or flat slab (Figure 1). Roost surfaces were concrete, steel, or wood. Many bridges had a combination of these surfaces, especially concrete and steel. Based on recommendations of Bat Conservation International (2001), we determined the following variables associated with each bridge: minimum and maximum roost height and crevice width, surrounding habitat (residential, agriculture, commercial, woodland, grassland, riparian), and area beneath the bridge (bare, vegetated, water, highway, dirt road, railroad, rip-rap). All bridges were checked during morning or afternoon when bats were roosting. A portable million-candlepower rechargeable spotlight was used to illuminate crevices, girders, and beams to locate bats. We did not use binoculars,

extension ladders, or extension mirrors to check more inaccessible places under bridges, however. Number and species of bats were determined based on morphological features; no bats were removed for identification.

Just as bats switch roost trees, there is both temporal and spatial variability in the use of bridges by bats. Therefore, we resurveyed some of the bridges that had bats to determine how many had bats present at a later date. We did this to calculate a correction factor for the possible number of bridges suitable for bats ("suitable" being defined as known bat use at some point in time) even though they may not have been occupied when we checked them and no sign (droppings, urine stains) was evident.

We anticipated analyzing the surrounding habitat data using logistic regression to separate bridges "with" and "without" bats and derive a predictive model. However, because too few bridges had bats compared to those that did not, we were unable to meet the basic assumptions necessary for this type of statistical analysis.

## RESULTS

Bats were found under 15 of the 232 bridges surveyed (Table 1). Four of the five types of bridges had roosting bats; only flat slab bridges never were occupied by bats (Table 2). Bat species we found roosting under the bridges were: big brown bats (*Eptesicus fuscus*), northern long-eared bats (*Myotis septentrionalis*), eastern pipistrelles (*Pipistrellus subflavus*), and little brown bats (*Myotis lucifugus*). The number of bats under each bridge ranged from 1 to > 100 (Table 3, Remarks). We found no bridges used by any of the state or federally listed species of bats. However, identification was sometimes problematic for bats in deep crevices or those roosting at substantial heights.

The average height for 9 roosts was 5.1 m (range 1.0 to 10.0 m). One individual roosted on a steel girder; all others roosted on concrete surfaces. The greatest concentrations of bats were in the crevices of parallel box beam bridges. Minimum crevice width of parallel box beam bridges used by bats was about 3/4" (1.9 cm); most bats were in crevices about 1" wide (2.5 cm) or greater.

We expected that heavily wooded areas of surrounding habitat would result in a higher percentage of observations of bats roosting under bridges. Although not quantified statistically, there was no discernable pattern to the immediate habitat directly under bridges used as roosts, or to the surrounding type of landscape (see Table 3, Remarks). Where flowing or standing water occurred under the bridges, bats usually roosted above the bare ground, concrete, rip-rap, or other material of the embankment, as opposed to over the water.

Of the 15 bridges with bats, 11 were rechecked at a later date to determine continuity of use. Seven of the 11 (63.6%) were being used by bats when rechecked. From this, we calculated a "correction factor" as $15 \div 0.636 = 23.6$ bridges. That is, given the temporal variation in bat use relative to time surveyed, we suggest that instead of 15 occupied bridges, a more accurate figure is 23.6 bridges. Thus, close to 10% of the 232 bridges surveyed could reasonably be considered suitable to house roosting bats.

## DISCUSSION

Previous work on use of bridges by roosting bats has been done primarily in the southern tier of the United States. Bat Conservation International (2001) estimated that in "... the southern U.S., 3,600 highway structures are used by approximately 33 million bats." Parallel box beam design bridges with 3/4" to 1" crevices (expansion joints) are most

frequently used by roosting bats (BCI 2001), although Arnett and Hayes (2000) suggest cast-in-place and I-beam bridges are preferred. Although most of the bridges with bats in our study were parallel box beam (7 of 15), on a percentage basis only 6.9% of these type bridges that were surveyed had bats (Table 2). We expect this figure would be higher except for the fact that crevices in southern Illinois often were filled with nests of mud-daubers (wasps of the family Sphecidae). We rarely found a roosting bat in close proximity to mud-dauber nests.

The overall percentage of bridges used in our study (6.5%) would be higher if the 30 flat slab bridges, primarily in the form of box culverts, are eliminated from the total. As noted, it is well known that flat slab bridges do not offer suitable sites for bats, probably because of their surface features, unsuitable microclimate, and exposure to potential predators. If those 30 bridges are eliminated from the total number surveyed, bats roosted in 7.4% of the four other bridge types surveyed (15 ÷ 202). Also, applying the correction factor noted previously to only 202 surveyed bridges, suggests 23.6 ÷ 202 = 11.7% of southern Illinois non-slab bridges are suitable for roosting bats. This figure must be considered conservative because of the possibility we missed seeing bats roosting at great height or in inaccessible portions of bridge structures. It is encouraging that such a large percentage, as well as four design types of bridges, are suitable for roosting bats.

Although we found no endangered species of bats during our study, at least Indiana bats are known to use bridges as roosting sites. Kiser et al. (1999) described three "concrete girder" style bridges used by night-roosting Indiana bats in south central Indiana. In Arkansas, a colony of 400-450 southeastern bats roosts in the expansion joints of a concrete bridge (D. Reed, Arkansas State University, personal communication, 2002).

McDonnell (2001) surveyed 990 bridges in the coastal plain of North Carolina and found bats under 135 (13.6%). Besides eastern pipestrelles, she found Rafinesque's big-eared bats and southeastern bats – the latter two species are considered state-endangered in Illinois. Likewise, Lance et al. (2001) found bats under 32 of 81 bridges in Louisiana; Rafinesque's big-eared bats made up > 95% of their observations. Although we found no Indiana, southeastern, or Rafinesque's big-eared bats in our sample of bridges, this likely is because of the restricted density and distribution of these species in Illinois (Herkert, 1992).

Recent work has shown that artificial roost boxes, placed under bridges, are an effective means of providing day and night roost sites for various species (Arnett and Hayes 2000, Bat Conservation International 2001). These boxes do not affect the structural integrity of a bridge and are very inexpensive to install. We had planned to place artificial roost boxes under selected flat-bottomed bridges to determine whether they attracted roosting bats. We did not place any artificial roosts, however, because state and county engineers responsible for bridge construction and maintenance were very reluctant to allow us to put them in place. It is important for resource managers to note that the primary concern and lack of enthusiasm for this project on the part of the engineers related to perceived possible impacts on their operations. Their concern was the potential we had of documenting threatened or endangered species of bats using the bridges. They feared this could directly impact future maintenance or other activities on these bridges. Also, they felt discovery of endangered species could result in additional mandated costs to counties that they could not afford. Any future efforts by the Illinois Department of Natural Resources to enhance use of bridges by roosting bats through the use of artificial boxes or other types of retrofitting to existing bridges (see Bat Conservation International 2001) will necessitate collaboration with state and county bridge engineers in Illinois to address

these concerns. Departments of Transportation in numerous other states (including Arkansas, Florida, Georgia, New Mexico, Oklahoma, Tennessee, Texas, Utah, and Wyoming) as well as the Federal Highways Administration (and other federal agencies such as the Army Corps of Engineers and Bureau of Land Management), successfully cooperate with resource managers in plans to accommodate bats in highway structures. A similar working relationship in Illinois should be encouraged, initiated, and maintained.

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Table 1. Number of bridges surveyed for roosting bats during the summers of 2001 and 2002 in 9 southern Illinois counties.

| County | # of Bridges Surveyed | # of Bridges With Bats |
|---|---|---|
| Franklin | 5 | 0 |
| Jackson | 66 | 5 |
| Johnson | 23 | 1 |
| Perry | 26 | 1 |
| Pope | 18 | 3 |
| Pulaski | 21 | 0 |
| Saline | 13 | 0 |
| Union | 36 | 5 |
| Williamson | 24 | 0 |
| Total | 232 | 15 |

Table 2. Design type of the 232 bridges surveyed during the summers of 2001 and 2002 in 9 southern Illinois counties[a].

| Bridge Design (and # surveyed) | # With Bats | # Without Bats |
|---|---|---|
| Parallel box beam (101) | 7 | 94 |
| Prestressed concrete girder (24) | 2 | 22 |
| Cast-in-place (27) | 2 | 25 |
| Steel I-beam (58) | 4 | 54 |
| Flat slab (30) | 0 | 30 |

a- Eight bridges had combinations of two design types, for example, parallel box beam was sometimes on each side of cast-in-place or slab bridges. Both designs were counted in a bridge so totals given here equal 240.

Table 3. Location, number, and habitat characteristics of bridges that had roosting bats during surveys of 2001 and 2002 throughout 9 southern Illinois counties.

| County | Date & Location | Bridge No. | Surrounding Habitat (SH) and Beneath Roost (BR) | Remarks |
|---|---|---|---|---|
| Jackson | 13 Jul 2001. Rt. 3 1.6 km S. Gorham. | S-0028 | SH – agriculture, woodland, riparian<br>BR – standing water | 1 Big-brown bat in crevice between cast-in-place and flat slab. 5 m above standing water. Rechecked 17 July 2002 - same species in same place. |
| | 14 Aug 2001. Highway 51 1.6 km N. Carbondale. | S-0063 | SH – residential, agriculture<br>BR – bare ground, rip-rap, flowing water | 1 Little brown bat on metal strip between I-beams. Rechecked 22 Jun 2002 – no bats. |
| | 14 Aug 2001. Giant City Rd west side of S. Illinois University. | C-5001 | SH – residential, woodland<br>BR – mowed vegetation, flowing water | 1 Little brown bat (?). On concrete near I-beam 10 m above Drury Creek. Rechecked 22 Jun 2002 – no bats. |
| | 14 August 2001. Boskydale Rd in Carbondale. | C-3124 | SH – woodland<br>BR – bare ground, open vegetation, flowing water | 2 Big brown bats roosting separately. Parallel box beam with 1.5" crevice over side of creek. Rechecked 22 Jun 2002 – 1 Big brown bat. |
| | 15 Aug 2001. Beaucoup Rd W. Vergennes. | C-3182 | SH – agriculture, riparian<br>BR – open vegetation, flowing water | 4 Big brown bats in crevice of parallel box beam bridge. 10 m above Beaucoup Creek. Rechecked 22 Jun 2002 – two clusters of 40-50 bats each. Extensive droppings. |
| Johnson | 19 Jun 2002. Rt 146 7.2 km W. | S-0014 | SH – woodland, grassland | 5-6 Big brown bats in 1 in crevices of |

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|---|---|---|---|---|
| | Vienna. | | BR – open vegetation, flowing water | parallel box beam bridge 8 m above Cache River. Bridge originally checked 9 Jun 2002 – no bats. |
| Perry | 8 July 2001. Rt 127 about 9.6 km S. Pinkneyville. | S-0010 | SH – agriculture, woodland<br>BR – bare ground, open vegetation, standing and flowing water | 4 Eastern pipestrelles; 3 Little brown bats. Prestressed girder bridge over Beaucoup Creek. Bats in joints 2.5 to 3 m above dry ground. Rechecked next day – no bats. |
| Pope | 15 Jun 2002. Rt. 146 about 7.2 km N. Golconda. | S-0023 | SH – agriculture, woodland<br>BR –open vegetation, standing and flowing water | 1 Big brown bat (?) about 6.5 m high in crevice of parallel box beam bridge. Rechecked 15 Jul 2002 – no bats. |
| | 15 Jun 2002. Rt 145 about 3.2 km S Dixon Springs State Park. | S-0024 | SH – agriculture, woodland<br>BR – bare ground, open vegetation, flowing water | Big brown bats included 12 singles, a cluster of 4 and a cluster of 7-10. May have been some Little brown bats. Parallel box beam bridge with 1 in crevices. Rechecked 15 July 2002 – about 24 Big brown bats in two clusters; singleton Northern long-eared bats (?). |
| | | | | |
| | 15 Jun 2002. 0.8 km W Rt 146 and 145 interchange. | S-0006 | SH – woodland, agriculture, residential<br>BR – open vegetation, standing water | 2 Big brown bats (?) in only 3/4" crevice of parallel box beam bridge. 6 m above standing water. Rechecked 15 July 2002 – 3 Big brown bats (?) in the same crevice. |
| Union | 13 Jul 2001. Rt. 146, 3.2 km W. Jonesboro near 146/127 intersection. | S-0029 | SH – residential, agriculture, commercial, woodland<br>BR – bare ground, flowing water | 1 Big brown bat in 1" crevice of parallel box beam and cast-in-place bridge. Bridge not rechecked. |
| | 13 Jul 2001. Rt. 127, 7.2 km N. of Rt. 146. | S-0068 | SH- agriculture, woodland, riparian<br>BR - bare ground, flowing water | 1 Northern long-eared, 1 pipestrelle, and a cluster of 8 pips on prestressed |

| | | | | |
|---|---|---|---|---|
| | | | | girder bridge. Rechecked 17 Jul 2002, 1 n. long-eared, 11 pips. |
| | 21 Jul 2001. 7900 Lake Road 4.0 km E. of Mill Creek | C-3112 | SH- woodland<br>BR – bare ground, flowing water | Cast-in-place bridge with 1 northern long-eared bat and a cluster of 5 juvenile eastern pipestrelles. Bridge not rechecked. |
| | 21 Jul 2001. Rt. 127, 0.8 km N. Mill Creek | S-0067 | SH – woodland<br>BR – bare ground, flowing waters | Steel I-beam bridge with 2 eastern pipestrelles. Bridge not rechecked. |
| | 19 Jun 2002. 6.4 km E of Interstate 57 on Rt. 146; N 2.4 km on Mt. Pleasant Rd. | C-3031 | SH – agriculture, woodland<br>BR – bare ground, flowing water | Steel I-beam bridge over Cache River with 2 eastern pipestrelles. Bridge not rechecked. |