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Use of Bridges as Day Roosts by Bats in Southern Illinois

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ABSTRACT

From May through July 2001, and June through August 2002 we surveyed 232 bridges in 9 southern Illinois counties for the presence of roosting bats. Fifteen bridges (6.5%) had bats roosting at the time they were surveyed. We encountered big brown bats (*Eptesicus fuscus*) most frequently. Eastern pipestrelles (*Pipestrellus subflavus*), little brown 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. Seven of the 11 (63.6%) were being used by bats when rechecked. From this, we derived an estimated usage rate of 23.6 bridges (15/0.636) during the study, or about 10% of the 232 bridges surveyed. We could not determine relationships between bat presence and habitat features around bridges.

Key words: big brown bat, bridges, eastern pipistrelle, *Eptesicus fuscus*, little brown bat, *Myotis lucifugus, Myotis septentrionalis*, northern long-eared bat, *Pipistrellus subflavus*

INTRODUCTION

Twelve species of bats occur in Illinois. Of these, four species are state or federally endangered (Herkert, 1992): the 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 bats that occur in Illinois is necessary for population assessment and effective species management. An important 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, where bats spend the majority of their lives, 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 is used by bats for roost sites, especially bridges with open expansion joints or alcoves (Davis and Cockrum, 1963; Adam and Hayes, 2000). Conversely, bats do not use flat-bottomed (slab) bridges (McDonnell, 2001), possibly because the microclimate is unsuitable. The extent of bridge use by bats, types of bridges that may be used, and discernable effect of 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 (Table 1). Only bridges that were maintained by state or county transportation departments 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. Five bridge designs were found in southern Illinois. Parallel box beam bridges were concrete with crevices (expansion joints) the length of the bridge that varied in width up to about 5 cm, were about 46 cm deep, and protected from above against moisture. Prestressed girder bridges were concrete with inverted T-shaped girders occasionally with steel bracing. Cast-in-place bridges had various patterns and sizes but were generally concrete "waffle-shaped" structures. I-beam bridges had steel girders in association with concrete or wood. Flat slab bridges were usually concrete box culverts with no crevices or girders. Many bridges had a combination of concrete, steel, or wood surfaces, but were primarily concrete and steel. We determined the following variables associated with each bridge: minimum and maximum roost height, crevice width of expansion joints, 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. The under surface of most bridges was close enough to the ground so that a complete inspection was possible. We did not use binoculars or extension mirrors, however, to check more inaccessible places under bridges. Regardless, binoculars or mirrors would not have been useful to detect bats higher than 20 m. Species of bat was 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 with bats to determine how many had bats present at a later date. We did this to calculate a correction factor to more accurately estimate 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. Because too few bridges had bats compared to those that did not, we were unable to meet the basic assumptions necessary for statistical analyses of surrounding habitat data to separate bridges "with" and "without" bats and develop a predictive model.

RESULTS

We found bats under 15 of the 232 bridges (6.5%) surveyed (Table 1). Four of the five types of bridges had roosting bats; flat slab was the only bridge type never occupied by bats (Table 2). Bat species found roosting under the bridges were big brown bats, eastern pipestrelles, little brown bats, and northern long-eared bats. The number of bats under each bridge ranged from 1 to >100. We recorded approximately 185 individual bats, with the largest concentrations in the crevices of parallel box beam bridges. Big brown bats comprised about 76.2% of the bats found, eastern pipestrelles 18.4%, and northern long-eared and little brown bats each < 3%. We found no state or federally listed species of bats using bridges. However, identification was sometimes problematic for *Myotis* 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) above ground level under bridges. One individual roosted on a steel girder; all others roosted on concrete surfaces. No bats roosted on wooden 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 approximately 3/4" (1.9 cm); most bats were in crevices ≥1" wide (2.5 cm).

We expected to observe a higher percentage of bats roosting under bridges located in heavily wooded areas. Although not quantified statistically, there was no discernable pattern to the surrounding type of landscape or to the immediate habitat directly under bridges used as roosts. 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, we rechecked 11 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 15/0.636 = 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 estimate is 23.6 bridges. Using this figure, close to 10% of the 232 bridges surveyed could reasonably be considered suitable for roosting bats.

DISCUSSION

Previous work on use of bridges by roosting bats primarily has been done 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." It has long been known (Davis and Cockrum, 1963) that roosting bats frequently use bridges with 3/4" to 1" crevices (expansion joints). Although parallel box beam bridges were used most frequently by bats in our study (7 of 15), on a percentage basis only 6.9% of the 101 bridges of this type that were surveyed had bats (Table 2). Crevices often were filled with nests of mud-daubers (wasps of the family Sphecidae), and we rarely found a roosting bat in close proximity to mud-dauber nests.

As noted, flat slab bridges offer limited suitable sites for bats, probably because of their surface features, variable microclimate, and exposure to potential predators. McDonnell (2001) found no bats roosting under any of the 161 slab bridges she surveyed. Lance et al. (2001) found that bats occupied only 1 of 14 slab bridges. The overall percentage of bridges used in our study (6.5%) would be greater if the 30 flat slab bridges, primarily in the form of box culverts, were eliminated from the total. Eliminating those 30 bridges from consideration, bats roosted in 7.4% of the four other bridge types (15/202). Also, applying the correction factor noted previously to only 202 surveyed bridges, suggests that 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 that we missed seeing bats roosting at great height or in inaccessible portions of bridge structures. It is encouraging that a potentially large percentage of bridges, as well as different design types, are suitable for roosting bats. Unfortunately, these bridge types might be less available in the future. As noted by Lance et al. (2001) and McDonnell (2001), more durable, less expensive, slab bridges often are built to replace older bridges that currently are suitable for bats.

Although we found no endangered species of bats during our study, several species that are listed in Illinois 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. 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). 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 often were reluctant to allow us to do so. 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 bridge maintenance operations. Their concern was the potential for documenting threatened or endangered species of bats using the bridges. This could directly impact future maintenance or other activities on these bridges, and could result in additional mandated, unaffordable costs to counties. 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 Highway 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 (Bat Conservation International, 2001). Similar working relationships should be encouraged, initiated, and maintained in all states.

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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	No. of Bridges Surveyed	No. 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 232 bridges surveyed for roosting bats during the summers of 2001 and 2002 in 9 southern Illinois counties[a].

Bridge Design (No. surveyed)	No. With Bats	No. 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 total number surveyed given here equals 240.