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GRAY BAT NIGHT-ROOSTING UNDER BRIDGES

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ABSTRACT—Many bat species use bridges as roosts for temporary resting places and thermal refuge between foraging bouts. We surveyed 37 bridges over waterways in northwest Georgia during the summer of 2000 and 2001 for night-roosting bats. We observed 20–30 gray bats (*Myotis grisescens*) night-roosting at two I-beam type bridges. Because of the long distances gray bats forage from their day roosts, these bridges may serve as important resting places. A more complete survey of bridges in northwest Georgia would be beneficial in determining the extent bridges are used as night roosts by bats.

Bridges are used as night roosts by many bat species (Adam and Hayes, 2000; Perlmeter, 1996; Pierson et al., 1996). Night roosts serve many functions including calling roosts for mating displays, perches for preying upon and consuming food, and as resting places (Kunz, 1982). Bridges retain solar energy absorbed during the day and emit this energy as heat during the night. The emitted heat provides thermal refuge for night-roosting bats. During the night, air temperatures under bridges commonly are greater (often by as much as 15° C) and more stable than ambient air temperatures (Adam and Hayes, 2000; Perlmeter, 1996). Little brown bats (*Myotis lucifugus*) in Oregon reduced energy expenditures by night roosting in the thermal refuge provided by bridges (Perlmeter, 1996).

Thermal characteristics of bridges and suitability as night roosts for bats are dependent upon construction design. Bridges with cast-in-place construction have inverted pockets that retain warm air. Bridges with parallel concrete or steel I-beams also trap warm air in their structures. In Oregon, big brown bats (*Eptesicus fuscus*), little brown bats, long-eared myotis (*M. evotis*), long-legged myotis (*M. volans*), and Yuma bats (*M. yumanensis*) have been found roosting in cast-in-place bridges and parallel I-beam bridges more frequently than wooden or flat-bottom bridges (Adam and Hayes, 2000). Bridge crevices have been used as day roosts by big brown bats, southeastern myotis (*M. austroriparius*), gray bats, little brown bats, evening bats (*Nycticeius humeralis*), and Mexican free-tailed bats (*Tadarida brasiliensis*) in the southeastern United States (Keeley and Tuttle, 1999).

In northwest Georgia, gray bats forage primarily over waterways such as rivers and reservoirs, and may forage > 30 km from their roost caves (Best and Hudson, 1996; LaVal et al., 1977; Menzel et al., 2000; Tuttle, 1976). Gray bats foraging great distances from their day roosts may use night roosts to rest and avoid the energy costs associated with returning to their day roosts between foraging bouts. In northwest Georgia, gray bats forage over streams and rivers such as Lookout Creek, South and West Chickamauga Creeks, and the Oostanaula River (Johnson, 2002; Menzel et al., 2000). We suspected that bridges over these and other waterways in northwest Georgia served as night roosts for gray bats. As part of a larger, systematic survey of gray bat foraging patterns, we surveyed bridges in northwest Georgia to assess the extent to which gray bats were using bridges as night roosts and to document the location and types of bridges used.

MATERIALS AND METHODS

We searched for night-roosting bats at 36 bridges between June and August 2000 and at a single bridge in July 2001 in northwest Georgia (Catoosa, Chattanooga, Dade, Floyd, Gordon, Murray, Walker, and Whitfield Counties). We noted if the bridge was unimproved (wooden), gravel, one-lane paved, two-lane paved, or an expressway (≥ 3 lanes). Expressway bridges (n = 3), two-lane paved bridges (n = 33) and one-lane paved bridges (n = 1) were examined. A spotlight was used to scan the undersides of bridges for night-roosting bats between 2145 and 0250 hours. Each bridge was investigated for several minutes on a single night. The extent of the search depended on the size of the bridge and the length of time required for us to determine if gray bats were using the bridge as a night roost. We also used Anabat II bat detectors (Titley Electronics, Ballina, Australia) to determine if gray bats were foraging over the waterway under each bridge.

RESULTS AND DISCUSSION

Gray bats night-roosted at 2 of 37 (5.4%) bridges investigated (Table 1). We found 20–30 gray bats roosting at the 2-lane paved Reed's bridge over the West Chickamauga Creek in Catoosa County at 0240 hours on 30 June 2000. The cluster of individuals was hanging on the concrete ceiling under the middle of the east end of the bridge. Large amounts of guano were found beneath the roost. Identification of echolocation calls collected from individuals foraging under the bridge verified the presence of gray bats and we were able to get close enough to the roost cluster to identify individuals roosting under the bridge as gray bats. At 0140 hours on 10 July 2001, we found 20–30 gray bats beneath the north end of the United States Route 27 expressway bridge over the West Chickamauga Creek in Walker County. We observed guano deposits under the north end of the bridge and recorded gray bat echolocation calls. Although gray bats were observed night roosting at only 2 of 37 (5.4%) bridges surveyed,

TABLE 1. Bridges surveyed for night-roosting gray bats in northwest Georgia, summer 2000–2001.

Year	Date	Time	No. calls[1]	Gray bats present	Location	County	Distance[2]	Nearest roost cave
2000	6/30	0140	8	N	Highway 2 over West Chickamauga Creek	Catoosa	9.1	Chickamauga
	6/30	0240	23	Y	Battlefield Parkway over West Chickamauga Creek	Catoosa	9.1	Chickamauga
	7/1	2315	0	N	Old Mill Road over South Chickamauga Creek	Catoosa	3.7	Chickamauga
	7/2	0100	10	N	Keith Drive over Tiger Creek	Catoosa	8.6	Chickamauga
	7/2	0200	0	N	Hopewell Road over Mills Creek	Whitfield	18.1	Chickamauga
	7/2	0220	0	N	Hopewell Road over Coahulla Creek	Whitfield	21.2	Chickamauga
	7/2	0250	0	N	Beaverdale-Cohutta Road NE over Coahulla Creek	Whitfield	19.7	Chickamauga
	7/3	0000	0	N	Mitchell Bridge Road over Sumac Creek	Murray	29.9	Chickamauga
	7/3	0115	0	N	Weber Road over Canasauga River	Murray	31.8	Chickamauga
	7/3	2300	4	N	Greenwood Road over East Chickamauga Creek	Catoosa	8.0	Chickamauga
	7/3	2340	0	N	Hackett Mill Road over Little Creek	Catoosa	5.2	Chickamauga
	7/4	0220	6	N	Alexander Bridge Road over West Chickamauga Creek	Catoosa	11.2	Chickamauga
	7/5	0010	0	N	State Route 157 over Rock Creek	Walker	10.5	Sittons
	7/5	0120	6	N	Lee Clarkson Road over West Chickamauga Creek	Walker	17.0	Fricks
	7/9	2310	1	N	Dug Gap Road over Swamp Creek	Whitfield	26.8	Lowerys
	7/10	0015	0	N	State Route 41 over Swamp Creek	Whitfield	29.4	Lowerys
	7/10	0100	0	N	Tilton Bridge Road over Conasauga River	Whitfield	32.7	Lowerys
	7/13	2340	0	N	State Route 100 over Clarks Creek	Chattooga	19.4	Lowerys
	7/14	2300	0	N	Roland Hayes Parkway SW over Oostanaula River	Gordon	17.8	Lowerys
	7/16	0010	0	N	State Route 225 over Mill Creek	Murray	31.9	Chickamauga
	7/17	0000	0	N	Blacks Bluff Road over Canasauga River	Floyd	31.5	Lowerys
	7/17	2220	0	N	Back Berryton Road over Raccoon Creek	Chattooga	17.0	Lowerys
	7/18	0130	1	N	Little Sand Mountain Road over Little Armuchee Creek	Chattooga	3.3	Lowerys
	7/18	2145	0	N	US Highway 11 over Crawfish Creek	Dade	6.4	Sittons
	7/21	2300	2	N	State Route 341 over West Chickamauga Creek	Walker	10.2	Fricks
	7/21	2330	21	N	Old Bethel Road over West Chickamauga Creek	Walker	12.1	Fricks
	7/21	2350	5	N	Baker and Hearn over West Chickamauga Creek	Walker	11.5	Fricks
	7/24	2230	0	N	Spout Springs Road SW over Big Cedar Creek	Floyd	39.5	Lowerys
	7/26	0115	7	N	Shattuck Industrial Boulevard over Chattooga Creek	Walker	16.1	Fricks
	7/26	2300	9	N	Reeves Station Road over Oostanaula River	Gordon	18.8	Lowerys
	7/27	2220	0	N	Trion-Teloga Road over Teloga Creek	Chattooga	17.6	Lowerys
	7/29	0110	7	N	US Route 76 over Mill Creek	Whitfield	19.1	Chickamauga
	7/29	0215	0	N	Sam Love Road over Mill Creek	Whitfield	20.2	Chickamauga
	7/31	2240	0	N	South Long Hollow Road over Chattooga Creek	Walker	18.1	Lowerys
	8/2	0045	0	N	Keith Mill Road SE over Coahulla Creek	Whitfield	32.1	Chickamauga
	8/4	0010	0	N	Minshew Road NE over Woodward Creek	Floyd	17.5	Lowerys
2001	7/10	0140	8	Y	US Route 27 over West Chickamauga Creek	Walker	16.5	Fricks

[1] Number of gray bat echolocation call sequences recorded with an Anabat II detector in a 20-minute sample period.
[2] Straight-line distance from bridge to nearest gray bat day-roost cave.

gray bat echolocation calls were collected over watercourses at 15 of 37 (40.5%) bridges investigated.

Surveyed bridges were 3.3–39.5 km straight-line distance from caves used by gray bats as day roosts. Reed's bridge was 9.1 km straight-line distance and 24.8 km riparian-corridor distance from the nearest gray bat day roost, Chickamauga Cave. United States Route 27 Bridge over West Chickamauga Creek was 16.5 km straight-line distance and 30.3 km riparian-corridor distance from the nearest gray bat day roost, Frick's Cave. Riparian-corridor distance was defined as the shortest distance between the bridge and cave following stream and river corridors. Both bridges had exposed, porous, concrete ceilings. The small cracks and holes provided places where bats could roost and rest. Both bridges had parallel I-beams that trapped warm air between them. I-beams trapped air that was noticeably warmer than the ambient air temperature. We did not observe any other bat species night-roosting at any of the bridges we surveyed. However, we were only searching for obvious clusters of bats and not solitary individuals that may have been roosting in expansion joints or other areas difficult to observe.

We found gray bats in northwest Georgia used at least two bridges as night roosts. These night roosts allowed gray bats to rest between foraging bouts without flying back to their day roost. Night roost use improves gray bat energetic efficiency, and may be an important behavioral adaptation considering the long distances gray bats forage from their day roosts (> 30 km). Considering the distance from Reed's bridge and the United States Route 27 Bridge to the nearest gray bat day roosts in northwest

Georgia, the energy savings are apparent. In addition to reducing flight costs, bridges provide thermal refuge that allows gray bats to conserve heat that would be lost if they roosted in the cooler surroundings at other night-roost types. Gray bats also exhibited a clustering behavior when night-roosting at bridges, further reducing energy expenditures (Perlmeter, 1996).

Gray bat night-roost activity was concentrated at the middle of the end portions of the I-beam-construction bridges. This is similar to findings of Adam and Hayes (2000) that indicated that bats used end chambers of bridges more frequently than center chambers. Unfortunately, newly constructed bridges in northwest Georgia had metal ceilings that, unlike the porous, concrete ceilings of older bridges, did not appear to provide a surface for gray bats to cling.

Pierson et al. (1996) found that big brown bats, long-legged bats, pallid bats (*Antrozous pallidus*), and Yuma bats night-roosted under the same bridges throughout their 4-year study. Further research is needed to determine if gray bats roost under the same bridges in successive years. In Oregon, peak use of bridges by bats occurred at 0300–0430 hours and few bats used bridges within 1–1.5 hours after sunset (Adam and Hayes, 2000). However, it is unknown when peak gray bat night-roosting activity occurs at bridges. It is possible that we missed night-roosting bats at some of the bridges we surveyed because we conducted surveys too early or late in the evening at these bridges.

To our knowledge, gray bats have not been observed night-roosting under bridges in any part of their range. It is unknown if gray bats use night-roost sites such as caves, trees, or other anthropogenic structures other than bridges. Gray bats have been observed day-roosting in cave-like environs such as storm sewers (Baker, 1965; Hays and Bingman, 1964) and barns (Gunier and Elder, 1971). Gray bat maternity day-roosts have been located in culverts and bridges (Keeley and Tuttle, 1999). Our survey indicates that bridges are serving some function in the nightly activities of gray bats. Further research is needed to determine if gray bats are selectively using certain bridge types, night-roosting in places other than bridges, and if bridges in northwest Georgia not included in our survey, as well as across the gray bat's range, are being used. We recommend that the two bridges in northwest Georgia used by gray bats as night roosts should not be modified until the potential effects of the modifications on gray bats are considered. If demolition of the bridges is necessary, similar parallel I-beam design or cast-in-place design bridges should be constructed, and this construction should not occur from late June to September. Future construction of I-beam or cast-in-place design bridges could potentially benefit gray bats in northwest Georgia.

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