

NOTES ON A WINTER COLONY OF BIG BROWN BATS AT WILLIAMSPORT, WARREN COUNTY, INDIANA

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ABSTRACT: A single hibernaculum for big brown bats (*Eptesicus fuscus*) in the attic of a large old apartment building was studied over five winters. The number of bats generally increased during a period characterized by mild winters during which temperatures in the attic apparently always remained above freezing. However, many bats left during a very cold period in the late winter of 1993, when at least part of the attic reached temperatures below freezing. Turnover in the population using the attic was high both among years and within years. The bats spread out over the available area with essentially no clustering. The bats had a tendency to return to their favorite sections of the hibernaculum, but individuals almost never returned to the exact same spot. Sex ratios varied from 50.0% to 74.2% males. Several bats spent both the winter and summer in this roost.

KEYWORDS: Bats, big brown bat, Chiroptera, *Eptesicus fuscus*, hibernation.

INTRODUCTION

Whitaker and Gummer (1992) reported on big brown bats (*Eptesicus fuscus*) in winter and concluded that, although some hibernate in caves and mines, the majority of the big brown bats in Indiana hibernate in buildings that maintain temperatures above freezing throughout the winter. Some of the buildings also support summer colonies, but most that serve as hibernacula lack summer colonies. Most of the buildings that serve as hibernacula in winter harbor only a few bats (1-10), but a few harbor as many as 70 or 80.

The purpose of this study was to evaluate population size, site fidelity, sex ratio, and summer use by big brown bats that hibernated in one specific hibernaculum, the attic of an old brick apartment building in Williamsport, Warren County, Indiana. In summer, this building contains a maternity colony of slightly over 200 individuals. A number of questions were asked about this colony of big brown bats:

1. Does the number of bats using the building for hibernation change between and within years?
2. How much turnover occurs between and within years?
3. How many bats are present in one year but not the next?

4. Do the bats go back to the same spot or the same general location each year?
5. Is the sex ratio similar among and between years?
6. Do hibernating bats also spend the summer there?

MATERIALS AND METHODS

The approach taken during this study was to examine the entire attic at Williamsport from 1 to 4 times per winter over 5 winters (1989-1993). The attic is big, about 40' x 60', but the ceiling is low (from 3 to 10 feet high), and few hiding places for bats are present. Therefore, nearly all of the bats could be captured during each examination. The bats generally hung from the rafters, although a few bats were nearly always found in the cracks between the beams. The attic was separated by partitions into five sections. On each visit to the attic, each bat was caught and weighed, its sex was noted, and it was either banded or its band number was noted.

The attic was first visited on 17 January 1989 (winter 1), and 22 bats were found. All were banded with small, white plastic bands. The colony was visited five times the following winter (winter 2) between 10 January and 6 April 1990. Some bats had removed their white bands, so starting in 1989-90 (winter 3), larger yellow plastic bands were used. A few bats chewed these off. Therefore, starting in 1991-92 (winter 4), metal bands were used. Old bands were left on individuals previously captured. Loss of bands from multiple-banded bats thus gave us a measure of the rate of disappearance of bands. In 1990-91 (winter 3), only one trip was made (19 December); one was made in winter 4 (31 December 1992); and 2 were made in winter 5 (2 January and 26 February 1993).

RESULTS

In the beginning, I assumed that some bats probably returned to the same hibernacula and perhaps even to the same hibernating spot each year. To test whether bats returned to the same spot in consecutive years, a numbered and dated tag was pinned on the building below each bat as we banded it during the first year of the study. However, after completing the second year's observations here and in other colonies, almost no bats were found in the same spot where they had been banded the year before, and we stopped putting up these tags. Favored spots, such as particular cracks, almost always contained hibernating bats. It was in these few favored places that the same individuals were found during more than one year. In general, bats simply spread out over the available space. In addition, the bats moved between different hibernacula within and between years (as evidenced by bats being present one year, gone the next, and returning later). Thus, repeated hibernation at the same spot in consecutive years by the same bat was the exception, certainly not the rule.

Although few bats return to the exact same place in consecutive years, I also examined whether they returned to the same general area. The attic had five separate sections which were used to assess whether the bats returned to the same

general vicinity each year. Twenty bats recorded more than once were always found in the same section – 1 for 4 years, 4 bats for 3 years, and 15 bats for 2 years (12 in consecutive years, and 3 in 2 years separated by one year when the bat was not seen at all). This finding seems to show a slight tendency by the bats to return to favored sections of the attic, and significantly more bats returned to the same section than would be expected by chance ($\chi^2 = 35.6$, $df = 1$). On the other hand, 3 bats occurred at different times in 3 separate sections, and 32 bats were found in two separate sections.

Although the number of samples taken differ, the high number of bats per visit for the five years were 22, 32, 33, 43, and 63. The number of bats wintering in this roost showed a significant increase during the study period ($\chi^2 = 25.2$, $df = 4$). The increase may have occurred because this study was done over a series of relatively warm winters. Within individual years, change also occurred. In 1989-90, 19 bats were present on 10 January, 31 on 2 February, 24 on 9 March, and 54 on 20 March. In 1992-93, 63 were present on 2 January (there had not been much cold weather to this date), but only 20 on 26 February. This latter date was at the end of a very cold period, and frost formed on the inside of the roof, especially in section 1. No bats were found in section 1 at this time, although bats were present here during every other visit.

No bat was recorded during every visit or during each year. Only one bat was recorded in four of the five years, and only 5 bats were seen in three of the five years. One bat was seen on six visits over 3 years, and one was seen on six visits over 2 years. One other bat was seen on five visits, and 5 were seen on 4 visits.

Obviously, the number of bats in the building's attic fluctuated both between years and within years (Table 1). Twenty-two bats were banded on 19 January in winter 1 (Table 1). Only three of these were seen the next year. One, a male, was seen on all five visits in 1989-90 but was never seen again. One bat was present in winter 3 but not winter 4, and another was present in winter 3 and winter 4.

The roost was visited five times in 1989-90, and a total of 94 different bats was seen, including the 3 bats banded in 1988-89. Of the 94, 53 were present on only one date, and 13 were present twice. Of those present only one time, 4 were present only on the first date, 10 were present only on the second date, 7 were present only on the third date, and 32 were present only on the fourth date. All nine bats taken on the last date that year had been previously banded. Fourteen bats were present twice (including those banded the previous year) in all different combinations (visits 1 and 2 = 1 bat; 1 and 3 = 2; 1 and 4 = 1; 1 and 5 = 1; 2 and 3 = 2; 2 and 4 = 2; 2 and 5 = 1; 3 and 4 = 2; and 3 and 5 = 1). Those present 3 times were one bat on visits 1, 4, 5; 1 on 1, 2, and 4; 1 on 1, 3, and 4; and 1 on 2, 4, and 5. Three were present on 4 visits, two of them on the first 4, and one on the first two and the last two visits.

In 1992-93 (year 5), the roost was visited twice. The total number of bats seen during the first visit was 64, of which 43 had not been previously banded.

Table 1. Recurrence of individual big brown bats in an attic in Williamsport, Indiana. (For example, of the 22 big brown bats captured on 19 January 1989, 19 were never seen again, 1 was seen on the next 5 visits, 1 was seen on 3 later visits, and 1 was seen on 4 later visits.)

Number of Bats	Sex		Winter 1 1988-89			Winter 2 1989-90		Winter 3 1990-91	Winter 4 1991-92	Winter 5 1992-93		
	M	F	17 Jan.	10 Jan.	2 Feb.	9 Mar.	20 Mar.	6 Apr.	19 Dec.	31 Dec.	2 Jan.	26 Feb.
Totals:			22	19	32	24	54	9	34	44	64	20
19	8	11	●									
1	1		●	●	●	●	●	●				
1	1	1	●		●	●			●			
1	1		●			●		●	●	●		
4	1	3		●								
10	8	2			●							
7	4	3				●						
32	13	19					●					
1	1	1		●	●							
1	1			●		●						
2	1	1		●		●	●					
1	1			●	●	●	●					
1	1			●				●				
1	1			●			●	●				
1	1			●	●		●	●				
2	2			●	●		●		●			
1		1		●						●		
1		1		●		●	●		●		●	
1		1		●	●	●	●		●		●	
1	1			●		●	●			●		●
5	5			●	●	●	●			●		●
1	1			●	●		●					
1	1			●	●			●				
2	1	1		●	●		●					
1	1	1		●	●		●		●			
1	1			●	●		●		●			
1	1			●	●		●		●			
1		1		●	●	●	●				●	●
1	1			●	●		●	●		●		●
1	1			●	●		●	●		●		●
1	1			●	●		●	●		●		●
1	1	1		●	●		●	●		●		●
1	1			●	●		●	●		●		●
1	1			●	●		●	●		●		●
2	2			●	●		●	●		●		●
2	1	1		●	●		●	●		●		●
1	1			●	●		●	●		●		●
1	1			●	●		●	●		●		●
13	9	4		●	●		●	●		●		●
4	4			●	●		●	●		●		●
2	1	1		●	●		●	●		●		●
1	1			●	●		●	●		●		●
21	13	8		●	●		●	●		●		●
8	7	1		●	●		●	●		●		●
1	1			●	●		●	●		●		●
1	1	1		●	●		●	●		●		●
33	26	7		●	●		●	●		●		●
10	6	4		●	●		●	●		●		●
7	4	3		●	●		●	●		●		●

Of the 21 that had been previously banded, 9 had been banded in year 2, 3 in year 3, and 9 on 31 December of the previous year. Other than those banded in the previous visit and one banded on 19 December 1990 (which was seen for 3 consecutive visits and 3 consecutive winters), none had been observed on every visit since the bat was first banded. Only one of the 9 bats banded in year 2 was observed in each year afterward. Some bands were being removed by the bats. One bat was given a white band on 19 January 1989 and a yellow band on 10 January 1990. However, by 20 March, this bat had lost the yellow band but retained the white one (one of two instances when yellow bands were lost).

New (unbanded) bats were constantly showing up throughout the study. The new arrivals coupled with the many absentees who later reappeared was convincing evidence that many bats moved between buildings throughout the winter.

Clustering of Bats. As Whitaker and Gummer (1992) discovered, little clustering occurred. The bats spread out over the available area. For example, of the 64 bats at Williamsport on 2 January 1993, all were solitary except for two pairs.

Sex Ratios. Winter sex ratios ranged from 50.0% to 74.2% males over the course of the study, varying somewhat both within and between years.

Relation Between Summer and Winter Use of the Buildings. Since the numbers of bats are much smaller in buildings in winter, even in buildings used both in winter and summer, the great majority of bats obviously hibernate elsewhere than in their summer roost. Since no winter roost has very many bats in winter (most less than 5), the bats from one roost apparently spread out and hibernate in a large number of buildings. One visit was made in the summer to determine the relationship of the summer to the winter bats. A total of 133 bats had been banded there in winter by that time (55 females and 78 males). On 19 December 1990, thirty-three bats were hibernating at Williamsport (24 males and 9 females). In the following summer (13 August 1991), 36 bats banded in previous years were present in the maternity colony (out of an estimated total of 280 bats). Most of the adults were assumed to be females, and about half of the bats were assumed to be young of the year. Therefore, about 36 of the 140 adult bats present were banded. Obviously, many of the bats had hibernated elsewhere, but a number of bats spent both the winter and summer in the hotel.

DISCUSSION

Big brown bats are essentially solitary in winter, each finding its own individual hibernating spot. The hibernaculum must remain above freezing throughout the winter. Big brown bats were found to move between hibernacula in winter in this and in other colonies. No apparent reason existed for their movement in and out of the hibernaculum as no particularly cold spells occurred during this period. Movement in and out of the hibernaculum may represent normal behavior for this species in winter. Whitaker and Gummer (1992) postulated that movement between hibernacula is beneficial to the bats if the movement makes them aware of additional hibernacula in the area that could be used in the event

of the loss of one through fire or from human intervention (building destruction, exclusion, turning off the heat, and so forth). The behavior of the big brown bat is very different from the behavior of some other species that hibernate in caves. For example, when hibernating in caves, the individuals of *Myotis lucifugus* and *M. sodalis* often congregate in clusters and show great fidelity to the hibernaculum, although some winter movement between caves does occur (Barbour and Davis, 1969; Fenton, 1966; Hall, 1962; Hardin and Hassell, 1970; Humphrey and Cope, 1976; Griffin, 1940; LaVal and LaVal, 1980). Because they are permanent, caves are relatively safe, and they provide a stable environment. Thus, returning to the same cave each year makes good evolutionary sense, although some cave switching does occur.

Big brown bats, on the other hand, have adapted to man's structures (especially to barns but also to churches, houses, and other buildings in the summer). Most of the buildings used in the summer are too cold to be used as winter hibernacula. Buildings, especially heated older ones like the apartment building the bats use in Williamsport, are particularly vulnerable to destruction or loss of ancillary heating. Therefore, the bats may need to find a new hibernaculum at any time, including midwinter. Big brown bats tend to be solitary in winter, but they are probably aware of additional hibernacula in the area in case they need to depart abruptly. Most hibernacula have low numbers of bats. A winter hibernaculum that has remained above freezing for a number of years may attract an increasing numbers of bats, because enough time has elapsed for the hibernaculum to be discovered by more and more individuals. The original hibernacula of big brown bats were probably trees. Like buildings, trees are also vulnerable to destruction; they can burn, blow over, or die. Perhaps, the bats that now use buildings as hibernacula originally used trees. Since the same risks would have applied to tree loss, the big brown bats were probably solitary there as well.

How does the Williamsport colony relate to these ideas? Williamsport has a large summer colony (several hundred bats), but only a small proportion of them use the apartment building's attic as a winter hibernaculum. The attic was available every year of the study, and the numbers in winter had been increasing, although a big decrease occurred on 26 February 1993, when only 20 bats were found. The increase was related to the weather, which was characterized by relatively warm winters during the study period. No exceptionally long cold periods (when the air in the attic would drop below freezing for more than a day or two) occurred in the first four winters of the study; thus, Williamsport remained a viable hibernaculum, accounting for the increase in numbers. However, in February 1993, an extended very cold spell occurred in which the temperature dropped far below freezing. The coldest part of the attic at Williamsport is section 1. On February 26, frost was found on the ceiling of section 1, and no bats were found there. Fewer bats were present in the other sections of the attic when compared to 2 January count (64 in comparison to 20). The cold caused many of the bats to leave the hibernaculum. They did not move downstairs or

anywhere else in the building, because no other space was available to them in the building.

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