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SEASONAL FLIGHT COUNTS IN THREE BIG BROWN BAT (*EPTESICUS FUSCUS*) COLONIES

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ABSTRACT: Big brown bats first appeared in maternity colonies in mid-March and increased to peak adult populations by the first week of May. Exits began an average of 1.5 to 15.1 minutes after sunset. The length of time for all bats to exit averaged 18 minutes in the smallest colony (peak count of 69 adults) to 44.1 minutes in the largest colony (peak count of 349 bats). Temperatures below 10° C or rain caused bats not to emerge. The fall population decline started in late August and early September, but some bats remained in the colonies through mid-November.

KEYWORDS: Big brown bat, *Eptesicus fuscus,* flight counts, populations.

INTRODUCTION

Most big brown bats (*Eptesicus fuscus*) hibernate alone in buildings in winter, at least in Indiana (Whitaker and Gummer, 1992; but also see Barbour and Davis, 1969 and Baker, 1983). Some hibernate in caves and mines (Beer, 1955; Beer and Richards, 1956; Phillips, 1966). The bats often move within and between roosts during the hibernation period (Goehring, 1972; Mills, *et al.*, 1975; Whelden, 1941). They start to form maternity colonies in March, and the colonies disband by early November (Mills, *et al.*, 1975; Whitaker and Gummer, 1992). However, few specific details on the buildup and decline are available.

The objectives of the present study were to examine changes in the number of big brown bats emerging at dusk from maternity colonies as related to season, weather, and bat biology. Specifically, we wanted to determine: (1) the dates of the beginning, progression, and completion of the spring increase and of the abandonment in the fall at maternity colonies; and (2) fluctuations in flight counts due to weather, the young becoming volant, bats moving, or other causes.

METHODS AND MATERIALS

Observations were made by Brian and Priscilla Leibacher at the Scotland Hotel in Greene County; by Darrel and Rita McKenzie at the Presbyterian Church in Roachdale, Putnam County (and two observations at the Jamestown church); and by Michelle Rakow at Mecca School in Parke County. The exits from the roosts were watched, and all the exiting bats were counted from approximately ½ hour prior to sunset until 15 minutes after the last bat left the roost. The data

recorded included the exit time of the first bat, the number of bats exiting each minute, temperature, wind, cloud cover, and the time the last bat exited. Temperature data were obtained from the National Weather Service and from on-site readings. All data were collected in 1989, except for supplementary data collected at the Scotland Hotel in 1995.

RESULTS

Jamestown and Roachdale. These colonies were both in churches. Only two observations were made at Jamestown (Table 1): the first was on 17 March, when 20 bats emerged, and the second was on 26 March, when 40 bats emerged. The first observations at Roachdale were on 26 March (23° C), when 24 bats emerged. None were seen on 7 April, probably because of the low temperature (6° C). On 14 April (13° C), 50 emerged; on 25 April (22° C), 148 emerged; and on 4 May (14° C, rain), 58 were counted. Maximum counts at Roachdale (Table 1) were 349 bats on 14 August (with young), and 306 bats on 14 May (pre-young). The Roachdale site is also used for hibernation by low numbers of bats (up to 5 per winter).

Scotland Hotel. This colony was in the attic of an old hotel. Observations were made on 15 March (temperature 4° C, cloudy), 23 March (11° C, clear), 30 March (11° C), 5 April (10° C, drizzle), 12 April (11° C, drizzle), and 20 April (17° C), but no bats were seen until 20 April, when 45 exited. The temperature and weather conditions on both 23 and 30 March were such that bats would have exited if present (insects were flying). The bats apparently had not begun returning by 30 March. No bats were seen on 5 or 12 April; however, it was raining on both those nights, which might have kept the bats from exiting. Unfortunately, no other nights were sampled. Therefore, we can only say that the first bats apparently returned between 30 March and 20 April. No bats hibernate at the hotel, as it is not heated in winter.

In 1989, 26 bats emerged on 12 October (15° C), 17 on 25 October (19° C), and none on 8 November (11° C). The bats had apparently left by the last date. Supplementary data were collected in 1995 (Table 1). Seventy-two bats exited on 4 September, but this number rapidly declined. The last bats seen exiting numbered 2 on 23 October (12° C). None exited on three nights in November or on 1 December. In 1995, bats were seen exiting from a heated building near the Scotland Hotel. The number exiting that building was 34 and 47 in late September, from 5 to 9 between 10 and 18 October, and 44 on 18 October. On 23 October and 2 November, 8 and 3 bats exited this building; none were observed on 9 and 13 November (temperatures 3° C and 4° C, respectively). However, on 1 December, 10 bats exited the building. Big brown bats exit in winter, especially on warm nights, and we believe these latter bats had begun hibernation.

Mecca. The colony at Mecca was in the attic of an old, but refurbished, school. Observations at Mecca School paralleled those at the Scotland Hotel. No bats were seen there during observations on 16 March (temperature -5° to 13°

Table 1. *Eptesicus* emergence counts at the Scotland (* = 1995 data), Mecca, and Roachdale (2 at Jamestown = **) colonies. Temperatures are in centigrade. R or C after the date indicates Rain or Cloudy.

SCOTLAND				MECCA				ROACHDALE			
	Temp	No.	Exit times		Temp	No.	Exit times		Temp	No.	Exit times
MAR				**MAR**				**MAR**			
15 C	4	0		16		0		17**	15	20	7:05-8:10
23	11	0		23		0		26**	23	40	7:15-7:58
30	11	0		31		0		26	23	24	7:18-7:45
APR				**APR**				**APR**			
5 R	11	0		7		0		7 C	6	0	
12 R	11	0		29	21	195	8:06-8:26	14 C	13	50	7:34-8:15
20	16	45	7:50-8:01					25	22	148	7:50-8:30
26 R	17	0									
MAY				**MAY**				**MAY**			
3	15	69	8:05-8:24	3	15	242	8:07-8:31	4 R	14	58	7:30-8:00
10	14	54	8:10-8:25	10	13	239	8:01-8:29	14 C	17	306	8:10-8:35
17	22	12	8:14-8:25	18	19	225	8:07-8:34	22 R	13	1	
24	23	15	8:15-8:23	24	22	201	8:17-8:40	29 C	21	176	8:20-9:00
JUNE				**JUNE**				**JUNE**			
7	24	8	8:25-8:48	8 C	23	212	8:18-9:07	11 C	24	245	8:25-9:05
21	27	29	8:29-8:48					26 C	28	210	8:25-9:03
JULY				**JULY**				**JULY**			
5	27	88	8:26-9:03	5	30	227	8:13-8:44	16	27	314	8:25-9:10
12	28	91	8:26-8:43	26	29	181	8:21-8:52	31 C	23	187	8:27-9:00
19	22	92	8:20-8:43								
AUG				**AUG**				**AUG**			
2	21	58	8:17-8:30	7	17	224	8:13-8:44	14	25	349	7:55-8:35
16	21	55	7:54-8:16	16 C	23	122	7:59-8:17	27 C	26	190	7:50-8:15
31	27	54	7:43-7:59								
SEPT				**SEPT**				**SEPT**			
4*	22	72	7:30-7:45	13	15	29	7:20-7:42	13 C	12	39	7:07-7:45
13*	21	36	7:15-7:40	20	19	212	7:13-7:31	25 C	13	72	7:05-7:40
20*	18	23	7:10-7:28								
25*	12	12	7:05-7:25								
27	17	5	7:07-7:18								
OCT				**OCT**				**OCT**			
2*	18	13	6:50-6:59	4	3	7	7:06-7:09	6	9	55	
8*	10	4	6:54-7:05	18	4	0		16	15	60	
12*	19	5	6:38-6:47	25	21	66	6:06-6:37	24 C	20	118	
12	15	26	6:37-6:52					31	3	0	
18*	16	3	6:26-6:45								
23*	12	2	6:21-6:42								
25	19	17	6:15-6:35								
NOV				**NOV**				**NOV**			
2*	7	0		1	3	0		12 C	10	53	5:35-6:20
8	11	0									
9*	3	0									
13*	4	0									
DEC											
1*	10	0									

C, min/max Rockville), 23 March (-2° to 14° C), 31 March (2° to 10° C), and 7 April (0° to 13° C); the first bats were seen on 29 April (14° to 23° C), when 195 emerged. The bats returned between 7 and 29 April. The maximum number of bats prior to flight by the young was 242 on 5 May; this was also the overall maximum (Table 1). About 6 to 20 bats regularly hibernate at Mecca.

DISCUSSION

Establishment of Maternity Colonies in Spring. Bats began returning to two of the maternity colonies by at least 17 March (Jamestown) and 24 March (Roachdale), whereas limited data indicate the arrival of the first bats at Scotland between 30 March and 20 April. The fact that 45 (more than half the ultimate total) emerged on 20 April suggests that the first bats probably arrived at the colony in Scotland closer to 30 March than to 20 April. At Mecca, the spring buildup began between 7 April and 29 April. Their arrival was probably much closer to 7 April as the full complement was there on 29 April. Big brown bats start the spring buildup in central Indiana in March or early April. In the spring, the full complement of bats was attained by about 14 May at Roachdale and 3 May at Scotland and Mecca.

Exit Times. In 1989, exit time showed a pronounced correlation with sunset time. The bats usually emerged between 1 and 15 minutes after sunset (earlier on overcast days). Exceptions occurred on 4 May at Roachdale, when the first bat exited at 7:30 P.M. (sunset at 7:47; misty; and the count was low), and on 5 July, 7 minutes before sunset (no weather information). However, at the Scotland Hotel on the same day (5 July), the first bat exited 6 minutes after sunset. The first bats leaving the hotel on that date flew erratically and may have been young.

Amount of Time to Exit. During the 18 nights on which more than 1 bat exited in Roachdale, the number emerging ranged from 39 to 316 ($\bar{x}$ = 147.4). The bats took from 22 to 45 minutes to emerge, averaging 35.3 minutes. No bats emerged on 7 April, when the temperature was 6° C, and only one emerged on 22 May, when it was raining. The number exiting the Scotland Hotel averaged 44.8 (8-91 bats, n = 16) in 1989. The bats took an average of 17.9 minutes to exit (ranging from 8 to 37 minutes). On the one night when it rained at exit time, none emerged. The bats averaged 16.3 minutes to emerge in the autumn of 1995. On 14 nights, the number emerging from the Mecca School ranged from 7 to 242 ($\bar{x}$ = 170.1). The bats averaged 25.4 minutes to exit (ranging from 3 to 49 minutes). On 4 October, the temperature was 3° C, and only 3 bats exited (exit time 3 minutes); on 18 October, the temperature was 4° C, and none exited. However, a week later, 66 exited when the temperature was 21° C. Cold, rainy nights clearly deter bats from exiting.

Temperature. Exceptions exist, but temperature clearly influences the number of bats exiting. For example (Table 1), at Roachdale, 25 bats were counted on March 26, when the temperature was 23° C, but one week later with a temperature of 6° C, no bats exited. Lower temperatures on which bats emerged

were 3° C on 4 October at Mecca, when seven emerged; 14° C at the Scotland Hotel on 10 May, when 54 emerged; and temperatures of 14°, 9°, 12°, and 13° C at Roachdale when 58 (4 May), 55 (6 October), 39 (13 September), and 1 (22 May, a rainy night) emerged. Large numbers of bats generally did not emerge at temperatures much below 10° C. Usually, fewer bats exited at temperatures less than 15° C, except for 14 May at Roachdale, when over 300 emerged at a temperature of 13° C. The same was true at Mecca, where on 10 May approximately 240 bats were counted when the temperature was 13° C. On 4 October, also at Mecca (3° C), seven exited; on 18 October (4° C), none exited; on 25 October (21° C), 66 were counted. On 1 November (3° C), bats were heard, but they did not exit. The temperatures were somewhat low (ranging from 9° to 15° C) at Roachdale between 13 September and 16 October, and the number of bats emerging was correspondingly lower, ranging from 39 to 72. However, on 24 October, 118 bats emerged at a temperature of 20° C. The Scotland Hotel seemed to have an erratic count relative to temperature. After the first exit count of 45 on 20 April (17° C), no bats emerged on 26 April, when it rained; high counts occurred on 3 May (15° C; 69 bats) and 10 May (14° C; 54 bats). However, no more than 15 bats emerged on 17 May, 24 May, and 2 June, even though the temperature was above 21° C, and there was no rain. Perhaps many of the bats were at an alternate location at that time. No bats exited from the Scotland Hotel or the nearby building on 1 or 8 November, 1989, when the temperature was 11° C. However, bats did emerge from the nearby building on 1 December at a temperature of 10° C.

Rain. It rained on 5, 12, and 26 April at the Scotland Hotel (Table 1), and no bats emerged. Since no bats had been seen at this colony by 12 April, they might not have been present. Forty-five bats emerged on 20 April at the Scotland Hotel, but none emerged on the night of 26 April, when it rained. On successive dates at Roachdale (25 April, 4 May, 14 May, 22 May, and 29 May), the bats emerging numbered 148, 58, 306, 1, and 176, respectively. It rained on 4 and 22 May, the two nights when numbers were greatly reduced. Rain clearly reduced the number of bats emerging. Sunset apparently has a greater influence on exit time than temperature, although very low temperatures or rain might deter the bats from exiting; cloudy conditions may cause early departures.

Fall Decline. The bat populations started declining in August or September. By 2 August, the number leaving the Scotland Hotel was reduced to 58 and then tended to level out with 55 being seen on 16 August and 54 on 31 August. On 7 September, the exit count was only 5; on 12 October, the number was 26; on 17 October, 25; and no bats emerged on 8 November, even though the temperature was 10° C. The major drop in count at Mecca from 122 on 16 August (23° C) to 29 on 13 September (15° C) followed by an increase to 212 on 20 September (19° C) is hard to understand, as the temperature was relatively high on all three nights. No bats emerged at Mecca on 1 and 8 November (3° and 10° C, respectively). The Roachdale Church bats arrived earlier (26 March) than those at the other two main sites, although the earliest arrival date was at Jamestown.

The bats also left Roachdale later (12 November count of 53; 10° C) and may have been there even later. Bat numbers declined, and most of the bats had left the maternity colonies by early November.

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