

Seasonal Activity of Bats at an Indiana Cave

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Abstract

The activity of bats at Donnehue's Cave, Lawrence County, Indiana, was studied by netting the cave entrance 20 times at intervals from August 1970 to August 1971 and in February 1973. Seven species of bats were represented in the 440 captured; *Myotis lucifugus* was taken in the greatest numbers, followed by *Pipistrellus subflavus*, *Eptesicus fuscus*, *Myotis austroriparius*, *Myotis keenii*, *Lasiurus borealis*, and *Myotis sodalis*, in that order. Data were gathered, by species, on nightly behavior patterns and sex ratios.

Introduction

Seasonal activity patterns of cave-inhabiting bats of Indiana have not been intensively studied, although Mumford (1958) investigated a population of *Eptesicus fuscus* in Donnehue's Cave (Lawrence Co.) over an eight-month period. There is considerable bat activity at some caves especially in August and September, when large numbers of bats can sometimes be netted at certain cave entrances at night. Many of these animals are evidently transients, for few can be found in the caves on days following netting and few are recaptured later in the season. This phenomenon of bats gathering at cave entrances, called "swarming" by some authors, requires more study. It sometimes affords the researcher an opportunity to capture relatively large numbers of several species of bats. Through a grant from the Indiana Academy of Science, we conducted an investigation of swarming and other activity at the mouth of Donnehue's Cave from August 1970 to August 1971 and gathered supplemental data in February 1973.

Our major objectives were to determine seasonal and daily bat activity at the cave at intervals throughout the year.

Materials and Methods

From 26 August 1970 to 31 August 1971, and in February 1973, we netted bats at the entrance to Donnehue's Cave 20 times (Table 1). The cave was visited in every month but January. On each visit a 12-meter mist net was set across the mouth of the cave so that most bats entering or leaving would be caught. The net was positioned well before dark to determine the start of the evening flight, and was generally left in place for several hours, usually until bat activity had slackened. In the summer months the net was frequently set until around midnight; in the colder months it was removed around 9 or 10 PM. It would probably have been beneficial to have left the net in place all night on each visit. We recorded the time that most bats struck the net and most were sexed when removed from the net. When possible, we noted which face of the net the bat struck; we hoped this would

indicate whether bats were entering or leaving the cave when caught. However, due to the milling of the bats about the cave entrance and since bats would sometimes avoid the net, our data were not reliable for such an analysis. Captured bats were summarized by the number captured per hour. We also tabulated netting times with reference to official sunset times.

We obtained temperature data from the Bedford waterworks, about 1.5 miles from Donnehue's Cave, for the nights on which we netted. Unfortunately, this station recorded the temperature only once per day (at sundown) and the data were of minimal use to us. We thank Cecil Hughes for making these temperature records available. Lawrence A. Schaal supplied us with daily maximum-minimum temperature data for the Bedford area on the days we netted the cave. We tended to pick the warmer nights for our visits, because we felt more bats would be active then. Below-freezing temperatures occurred only on 16 March, 16 April, and 12 February. Since the lowest daily temperature normally occurs near dawn, probably at no time during our netting operations was the temperature below freezing. Thus, the bats were not exposed to extreme cold.

Most bats were banded with United States Fish and Wildlife Service bands and released soon after capture, but some were released unbanded and a few of each species were collected for food and parasite studies (Whitaker and Mumford, 1971).

The following persons often assisted with field work: David A. Easterla, Richard C. Tuszynski, Harmon P. Weeks, Jr. In addition, Easterla netted Donnehue's Cave on the night of 23-24 October 1971 and supplied us with his notes. Others who helped gather data were Douglas M. Knudson, D. David Pascal, Jr., Richard L. Powell, Jill Redgrave, and Peter Redgrave.

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Results

Of the 440 bats of seven species captured (Table 1), the little brown myotis (*Myotis lucifugus*) was taken in the greatest numbers, followed by the eastern pipistrelle (*Pipistrellus subflavus*). The capture of 7 red bats (*Lasiurus borealis*) is of interest, for this is not a cave-inhabiting bat under normal conditions. With the exception of the red bat (presumably a migratory species), all bats netted were forms that hibernate in Indiana. We caught bats every trip but 2, including 6 of the 7 trips from November through March, when the bats should have been in hibernation. This is further indication that there is a good deal of winter movement among hibernating bats in Indiana.

The greatest numbers of bats taken per hour were in August (15.8) September (10.4), and July (5.6). We had no evidence of a spring flight comparable to the fall swarming flight, although the fourth highest rate of capture (4.2 bats per hour) was in May. Observations on the various species follow.

Myotis lucifugus. This bat was taken far more often than any other. The 191 captures occurred in every month but January (no visits made), February, and November, but only one was taken in December, indicating little winter activity.

None was taken before sunset, only 16 in the first hour after sunset, and equal numbers during each of the next three hours. Nine were caught more than five hours after sunset (Table 2). In Indiana few *M. lucifugus* are collected by shooting at dusk—a time when *Lasiurus borealis*, *Pipistrellus subflavus*, and *Eptesicus fuscus* are commonly shot. Evidently most *M. lucifugus* remain in their daytime roosts until it is dark, or nearly so.

TABLE 2. Number of bats of selected species captured per hour, Donnehue's Cave, Indiana, 26 Aug. 1970 to 31 Aug. 1971.

Time and Effort (in hours)	<i>Myotis lucifugus</i>		<i>Pipistrellus subflavus</i>		<i>Eptesicus fuscus</i>	
	No. caught	No./Hour	No. caught	No./Hour	No. caught	No./Hour
Before Sunset (8.1)			4	1.3		
Sunset + 30 minutes (7.1)	7	1.0	10	1.4	1	0.1
31—60 minutes (8.8)	9	1.0	12	1.4	5	0.6
61—90 minutes (9.8)	23	2.3	6	0.6	10	1.0
91—120 minutes (9.3)	26	2.8	9	1.0	6	0.6
121—150 minutes (8.0)	22	2.8	9	1.1	11	1.4
151—180 minutes (6.7)	18	2.7	14	2.1	3	0.5
181—210 minutes (5.5)	20	3.6	17	3.0	8	1.5
211—240 minutes (4.3)	17	4.0	18	4.2	5	1.2
241—270 minutes (3.7)	18	5.0	22	6.0	3	0.9
271—300 minutes (2.6)	9	3.3	12	4.4	3	1.1
301—330 minutes (1.5)	9	6.0	3	2.0		

We banded 85 male and 19 female *M. lucifugus* in August and September, 1970, but recaptured (once each) only 6 males and 3 females later in that season. This points up the transient (or possibly erratic) nature of the swarming population. However, that many of them do return to a specific locality from time to time was indicated by our recapturing four females and fifteen males (nearly 20 per cent of those banded) at a later date. Three *M. lucifugus* banded 10 miles SE of Donnehue's Cave (at Tunnelton) and one banded at Donnehue's Cave by J. B. Cope were recaptured by us. One was a female banded 14 August 1958 at Tunnelton and netted 31 August 1971. A male banded 31 August 1960 at Donnehue's Cave was recaptured 16 September 1970. The other two had been banded in 1969 and 1970.

On 2 December 1970, we netted a male *M. lucifugus* as it was leaving the cave, banded and released it outside the cave at 5:35 PM, and netted it entering the cave at 6:16 PM. The only other bats netted that night were a male and female *Eptesicus fuscus*.

Pipistrellus subflavus. The second most abundant species netted was the pipistrelle, of which we caught 122 males, 17 females and 4 of unrecorded sex. The first were taken in May, and only one was taken after September (in October). Evidently *P. subflavus* is not as hardy as *P. hesperus*, which O'Farrell and Bradley (1970) observed in Utah flying about outside its roost when the air temperature was -8° C. *Pipistrellus subflavus* emerges relatively early in the evening, frequently being seen in flight while the sky is still fairly light. We netted 4 before sunset and 22 the first hour after sunset, but many (83) were captured between 2.5 and 5 hours after sunset, 22 of these 4 to 4.5 hours after. On 8 of the 11 nights *P. subflavus* was netted, it was the first species to enter the nets.

We banded 37 males and 6 females. Four males were recaptured once each 12 to 26 days after banding. Four other males were recaptured 8 to 12 months later.

Eptesicus fuscus. The 57 big brown bats captured were considerably less than we had expected. During the winter of 1954-55, at least 109 *E. fuscus* utilized Donnehue's Cave from August to April (Mumford, 1958). Whether present data reflect a true decline we do not know, for we lack data to determine normal, annual population fluctuations of this species in winter quarters. We captured 38 males, 18 females and 1 of unrecorded sex. *E. fuscus* was taken at the highest capture rate (2 per hour) and in greatest numbers in August, but individuals were taken in every month but April. Also, during Mumford's study of this cave no *E. fuscus* was seen on 12, 17, 23, or 28 April 1955. This is a hardy species, known to change hibernacula throughout the winter (Mumford, 1958; Mumford and Wilson, unpublished). Six were netted within one hour after sunset and only one within 30 minutes after sunset; 43 were captured between one and four hours after sunset. This species emerges relatively early, but not as early as *Pipistrellus subflavus*. We recaptured only two bats of this species, one female seven months after banding and one male nine months after banding.

Myotis austroriparius. We caught 23 of the 25 netted between 26 August and 18 November; the others (males) were caught 11 May and 4 February. Twelve were females. This species has been recorded regularly from Donnehue's Cave since 1954. We wished to determine if there was a maternity colony there, but we netted no *M. austroriparius* between 11 May and 31 August, indicating that no such colony was present. There is no breeding record for this species in Indiana, although specimens have been taken each month of the year. This bat is a relatively late flyer. We netted none earlier than an hour after sunset and some were captured up to 5.5 hours after sunset.

Of 14 *M. austroriparius* banded, 6 were recaptured. A male banded 26 August was netted 22 days later. A female banded 26 August

was netted 30 September and 30 October the same season. Another male banded 16 September was recaptured 14, 28, and 35 days later. Three others were recaptured about a year after banding. It seems likely that *M. austroriparius* utilizing Donnehue's Cave in the fall are less transient than *M. lucifugus* there.

Myotis keenii. We netted 15 males and 1 female; none was caught from 30 September to 16 April. The lone female was netted 30 September. We caught one *M. keenii* before sunset and nine within the first two hours after sunset. From our small sample, this species would appear to be an early flyer.

A male banded 8 June was recaptured 14 July and 23 October the same season. Another male banded 26 August was netted nine months later.

Lasiurus borealis. The seven red bats (3 males) were caught in July, August and September. This tree-living species is seldom found in Indiana caves, although skulls and other remains have been reported (Hahn, 1907; Mumford, 1953). Why red bats can be netted at cave entrances (and sometimes some distance inside the cave) in late summer and early fall is unknown.

Myotis sodalis. A male was captured on 9 August 1971. *M. sodalis* is quite rare in Donnehue's Cave, which has been studied by one of us (REM) since 1954.

Discussion

We hope later to compare species composition of bats at various cave entrances and try to determine why some species find particular caves so attractive and shun other caves which (to us) appear similar. For example, August and September netting at Ray's Cave, Greene County, Indiana, resulted in the taking of many more *Myotis keenii* and *Myotis sodalis* than at Donnehue's Cave.

We collected insects inside the entrance of Donnehue's Cave in hopes of determining if bats were attracted to the cave for feeding purposes. There was no evidence from the stomach analyses of bats that bats were feeding on insects inside the cave entrance, although small numbers of various insects took refuge there. Also, we have not determined whether insects are more abundant just outside the cave entrance than in the surrounding woods. One might explore the possibility that bats and perhaps also insects are attracted to the cave entrance by the temperature gradient at or near the cave mouth or by the cool air issuing from the cave in warm weather.

There are some problems inherent in this research. It is not known how much alteration of behavior might be caused by our disturbance, especially netting at frequent intervals. Perhaps many bats avoid the net after once being captured. Or, they might even avoid the site for a period of time. We feel that nightly netting of cave entrances followed by daily checks throughout the cave to determine what percentage of bats handled the previous night utilize the cave during the daytime would be instructive. Obviously, one should pick the cave carefully in order to sample one where most or all of the

bats entering and leaving could be caught and where most or all of the bats inside the cave could be found in the daytime. Also, nets should be left in place throughout the night to more accurately determine activity patterns.

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