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Presence of female *Myotis myotis* in nursery colonies

By A. Zahn

Zoologisches Institut, Universität München, München

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Population densities and colony sizes of the greater mouse eared bat (*Myotis myotis*) have been reported for many parts of Central Europe (Hedergott 1993; Helversen et al. 1987; Horacek 1985; Hurka 1988; Roer 1986; Rudolph and Liegl 1990; Spitzenberger 1993; Tress et al. 1989 a, b, c). Most reports are based on counts of bats in nursery colonies which consist mainly of females and their offspring. However, not all specimens occupy the same diurnal roost every day (Roer 1988). In particular one year old females seem to be regularly absent from colonies. Only 16 to 54% of females born the previous year were present in summer colonies during counts at a number of sites (Haensel 1980; Horácek 1985; Oldenburg and Hackethal 1989; Roer 1968). However, in these cases the samples were taken once a year. Therefore the counts do not show how many females live in the colony, but how many are (on the average) present on a particular day. When bats do not return to the roost every day, a colony may be larger than indicated by a count on a specific visit.

In order to gain more information on the presence of female *Myotis myotis* at their rosts, I checked the presence of individually banded bats in colonies regularly each summer over a period of three years (1991–1993) in an area of 4 000 km^2 located in the southeastern part of Bavaria (47°49′ N and 11°12′ E) where 22 nursery colonies were known Zahn 1995). In three colonies (Au: about 700 adults; Litzldorf: about 45 adults; Beyharting: about 200 adults) I monitored the presence of the marked individuals one to four times a month between May and August. The other colonies were also visited at least once a month in order to detect movements of banded bats (Zahn 1995). I did not visit the colonies after cold or rainy nights to avoid counting during times when many bats do not return to their roost (Audet 1990, 1992). However, local showers may have influenced some colony members in some cases: In the study area near the Alps local and short thunderstorms occur frequently in summer. Even when no rain was observed at the colony sites during the night, some bats may be prevented from returning to the roost by showers in the foraging areas, which can be located more than 15 km from the roosts (Güttinger 1994).

Banding of bats started during two previous studies, conducted in the same area between 1987 and 1990 (Audet 1992; Vogel pers. comm), when 214 females were marked in the colonies at Au and Litzldorf. In August 1991 I banded a further 116 young females in the colony of Au, 53 in the colony of Beyharting and another 52 females (adult and subadult) at male roosts in the study area (Zahn 1995). Each bat was banded with an aluminium ring (Zool. Museum Bonn). I fixed coloured spots of reflective tape to the aluminium rings to identify the bats over a distance of about two meters. Bats banded in the previous studies with plastic rings, could be identified over a distance of about 3 meters.

It was not possible to identify and to count all the banded individuals in a colony at

every visit, due to the density of the clusters and the bats' occasional use of alternative, partly hidden roosts at cooler places in the attics during hot weather. In the colony of Au, so many bats had been banded that it was not possible to identify all marked bats without disturbing the colony. Only the total number present was counted.

Definitions for each of the terms used in this study are given below.

Identified bats: the total number of banded females I located at a colony during one summer.

Maximum number of banded bats present: the maximum number of banded females which were present during a single visit to a colony

Average number of banded bats present: the average number of banded females at a colony (mean of all visits to a colony in one summer)

Average colony size: the average number of adult bats present in a colony in summer during periods of fine weather.

Maximum observed colony size: the maximum number of adult bats observed in a colony in summer.

Total colony size: the number of all adult bats living in a colony during summer.

Table 1 gives the number of the identified females in the colonies at Litzldorf and Beyharting and the presence of these individuals at the roost. The banded females observed in Au (where the bats could not be identified individually) are given in table 2. I never observed all identified bats of a colony at the same time at the roost. One year old females were absent from the colonies most frequently.

If all four samples of identified bats at least two years old (Beyharting and Litzldorf: 1993 and 1994) are summarised, on average 65% and at most 81% of those females were present when the counts were conducted (mean values of the four samples).

Table 1. Number of identified bats and their presence in the colonies of Beyharting and Litzldorf

colony	year	age of the bats (years)	IB (identified bats)	minimum presence (% of IB)	maximum presence (% of IB)	average presence (% of IB)	N (number of counts)
Beyharting	1992	1	13	31%	69%	57%	10
Beyharting	1993	2	11	27%	73%	59%	4
Beyharting	1994	3	7	14%	86%	61%	4
Litzldorf	1993	>2	15	53%	80%	68%	6
Litzldorf	1994	>3	12	58%	83%	72%	4

Table 2. Presence of banded bats in the colony of Au

colony	year	age of the bats (years)	MB (maximum number of presents bats)	minimum presence (% of MB)	average presence (% of MB)	N (number of counts)
Au	1992	1	48	25%	58%	7
Au	1993	2	40	63%	83%	5
Au	1993	>2	37	68%	82%	6
Au	1994	>3	62	74%	91%	5

In these cases the average values are about 80% of the maximum number of banded bats present, which coincides roughly with the observations in Au, where 85% (mean of the three samples) of the maximum number of at least two years old bats were present on average.

Counts of *Myotis myotis* leaving their roost at dusk at the three study colonies were conducted on 3 to 6 evenings at each colony evenings during periods of fine weather between the end of May and the beginning of July. The average colony size of the 3 colonies was 92%, 92%, and 91% of the maximum observed colony size for Beyharting, Litzldorf, and Au, respectively.

This difference between the maximum and the average observed colony size can be compared to the difference between the average and the maximum presence of banded bats at the roosts: For bats at least two years old the average presence (mean of all 7 samples) is 83% of the maximum presence and for one year old bats the average presence is 70% of the maximum presence (mean of the two samples of young bats banded in Au and Beyharting). One year old females represent about 10–11% of the females living in a colony in summer (Zahn 1995). Thus the average presence of banded bats of all ages is about 82% of the maximum number of bats. Therefore a difference of about 10% exists between the average number of banded bats present (82%) and the average colony sizes (91–92% of the maximum observed colony sizes) but this may be caused by the methodological problems mentioned below.

However, this comparison shows that there is a considerable difference between the average and the maximum number of bats present in a colony during times of fine weather.

The low average presence of one year old females at the study colonies may indicate that most of them are not reproductive. Only about 10% of the females studied by Horácek (1885) gave birth during their first year of life. If most of the one year old individuals do not have to care for offspring they may spend the day at other roosts more often than reproductive females.

Regular counts of colony sizes by other authors also indicate that many bats frequently are missing in colonies in spite of fine weather. Rogée and Lehman (1994) report that colony sizes already decreased in June during years with a high juvenile mortality. They assume that females may have left the colony after their offspring had died. Roer (1988) presents data of a colony in the Eifel (Germany) which shows fluctuations up to about 30% during periods of warm weather. In 1991, Audet (pers. com.) counted bats leaving the colony at Au at dusk 11 times during dry weather (6.6.–7.7). The average value was 91% of the maximum observed colony size.

Additionally my data indicate a difference between the maximum observed colony size and the total number of females living in a colony: It never happened that all banded individuals were present in a colony at the same time (maximum number of bats present in a colony < number of identified bats). During most visits more than a quarter of the banded bats were not observed in the study colonies.

However, it is difficult to apply this figure to other colonies because of several methodological problems. In Au, where the sample size was high, the bats were not identified individually. Thus I could not prove whether the maximum number of banded bats present was lower than the number of banded individuals that lived in the colony, as is the case for Beyharting and Litzldorf.

Additionally, the counting in Au was diffcult as a consequence of the large size of the colony and the large number of banded bats. In Beyharting and Litzldorf the sample sizes were very small. Furthermore, if identified bats had died in summer they might have been regarded as missing for the rest of the season. Such mortality may have increased the difference between the number of identified bats and bats present.

In conclusion I recommend that future investigations on larger samples of *Myotis myotis* should examine the percentage of daily missing bats to allow more exact determinations of total colony sizes and population densities.

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Author's address: Dr. Andreas Zahn, Zoologisches Institut, Universität München, Postfach 20 21 36, D-80021 München.