Activity Levels of *Myotis lucifugus* and *Myotis septentrionalis* in relation to Habitat Type and Insect Abundance

Andy Baltensperger, Student
University of Michigan Biological Station
Prof. Phil Myers, Field Mammalogy
8/12/2000

Abstract

To determine the habitat preferences of *Myotis* spp. we used bat detectors and tape recorders to measure the level of bat activity in four habitats in the northern lower peninsula of Michigan: riverine, lakeside, forested and disturbed. Activity was measured by the number of passes by *Myotis* spp. per night over a two-week period in July and August between 9:30 and 11:30 p.m. In addition, insects were collected at each site during the same time period and counted to test for a relationship between bat activity and insect abundance. Activity levels of *Myotis lucifugus* and *Myotis septentrionalis* were not determined by insect abundance or habitat type, although *Myotis* spp. exhibited a marginally significant preference of riverine habitats.

Introduction

As habitat loss becomes an increasingly serious problem for many species (including bats), it is important to establish which environments and conditions are essential for their survival. Due to the low levels of acoustic interference over water, bats are believed to prefer riparian over forested areas (Grindal et. al., 1999). Bats tend to avoid heavily forested areas because of the numerous obstacles which interfere with foraging and navigation (Hickey & Neilson, 1995). In addition, many larger bats with low maneuverability tend to favor open mature forests over "cluttered" younger growths, because of echolocative interference (Kalcoiunis et. al., 1999). In order to avoid such interference, larger species often fly above the forest canopy when foraging and commuting (Kalcoiunis et. al., 1999). However, because *Myotis* spp. are smaller and more agile, they are capable of exploiting higher densities of prey beneath the canopy. As a result, they are found in a variety of habitats including riparian and forested

(Crampton & Barclay, 1998). Nonetheless, they *prefer* open areas and tend to avoid forested areas, especially younger growth (Hickey & Neilson, 1995; Crampton & Barclay, 1998).

One reason for this habitat preference is the distribution of insects (bats main food source) within these areas. Insects generally congregate over water in higher numbers than in forested habitats. We would, therefore, expect to observe more insectivorous bats (like *M. lucifugus* and *M. septentrionalis*) in riparian habitats (Grindal et. al., 1999). Additionally, one would expect the numbers of bats in open clear-cut and disturbed areas to be somewhere in between that of forested and riparian habitats. This is most likely because of the lack of interference but also because of the lack of insects in these habitats (Crampton & Barclay, 1998; Grindal et. al., 1999; Kalcounis et. al., 1999). Using ultrasonic detectors, we examined whether the activity levels of *Myotis* spp. were related to habitat type and insect abundance within these habitats.

Methods & Materials

Research was conducted by 11 University of Michigan students between July 22 and August 4, 2000 in southwestern Cheboygan and Emmet Counties in the northern lower peninsula of Michigan. We observed bats in four habitat types: lakeside, riverine, forested and disturbed (all were bordered by forest). Each habitat type consisted of at least one sample area (Table 1). All of the sample sites were visited by people no more than twice a week, with the exception of the disturbed areas which were visited daily.

Groups of two observers recorded bat calls between 9:30 and 11:30 p.m. with the Anabat II ultrasonic detector attached to a tape recorder. Sensitivity on the Anabat was set at seven and division ratio at 16. Observers manually activated the tape recorder as soon as bat calls were detected. Recorded calls were transferred onto a computer and stored as visual frequency waves with the Anabat 5 program. We identified species by comparing calls to a library of bat calls. The number of passes by *Myotis septentrionalis* and *Myotis lucifugus* were counted, while those of other species were discarded. A pass was defined as a series of pulses separated by another series by an interval of at least three seconds.

To estimate the abundance of insects in each sample area, observers used sweep nets to capture insects midway through the observations. Insects were captured either once or twice during the observation period. Nets were swept in a figure-eight pattern for five minutes at heights between one and three meters above the ground in a five meter radius. Captured insects were collected using an aspirator, then identified by family and counted for each night.

HABITAT	LOCATION	DATE
Maple River (riverine)		
East Branch	T37N R4W, Sec 25, SE 1/4 of NW 1/4	7/24
Lake Kathleen	T37N R4W, Sec 25, SE 1/4 of NW 1/4	7/30
Maple River Rd.	T36N R4W, Sec 23, NE 1/4 of NW 1/4	8/1
US31 railroad bridge	T36N R4W, Sec 33, NE 1/4 of SW 1/4	8/3
Douglass Lake (lakeside)		
Pine Pt. Beach	T37N R4W, Sec 27, SE 1/4 of SW 1/4	7/25, 7/28
Forested		
Linker Spring	T37N R4W, Sec 33, SE 1/4 of SE 1/4	7/26
Pine Pt.	T37N R3W, Sec 27, NE 1/4 of SW 1/4	7/31
Disturbed (clear-cut)		
UVA Field	T37N R4W, Sec 33, S 1/2 of NE 1/4	8/1
Ball Field	T37N R4W, Sec 33, S 1/2 of NE 1/4	8/4

Table 1. Locations and dates of observations, arranged by habitat type.

Results

We determined: 1) whether bat activity was related to the abundance of insects and 2) whether bat activity was related to habitat type. A Spearman rank correlation coefficient test was used to examine whether the number of bat passes was related to the abundance of insects (Table 2). We concluded that the number of passes was independent of the abundance of insects in the area ($r_s = -.250$, $p = 0.389$, $n = 14$).

Night/Date		Number of Passes	Number of Insects
1	7/24	16	2
2	7/24	20	12
3	7/25	4	8
4	7/26	6	3.5
5	7/26	0	3
6	7/28	22	12
7	7/28	2	16.5
8	7/30	155	8.5
9	7/31	14	9
10	8/1	10	7
11	8/1	75	0
12	8/3	6	2
13	8/3	129	2
14	8/4	27	1

Table 2. Number of passes by M. lucifugus and M. septentrionalis and number of insects caught, arranged by date. Fractions of insects are a result of inconsistent sampling methods (see Discussion).

To test whether the frequency of bat-passes was related to habitat type, data were analyzed using Kruskal-Wallis one-way analysis of variance ($p = 0.063$, $df = 3$; Table 3).

	Douglass Lake	Forest	Maple River	Disturbed
Number of passes	4	6	16	6
	22	0	20	27
	2	14	155	
		10	75	
			129	
Average	**9.3**	**7.5**	**79**	**16.5**

Table 3. Number of passes by M. lucifugus and M. septentrionalis according to habitat type.

Discussion

Bat activity, indicated by number of calls detected by the Anabat system, was dependent neither on insect abundance nor habitat type. If insect abundance is relatively unimportant, habitat preference by *Myotis* spp. might depend on other conditions such as access to drinking-water, navigational ease, and the availability of roosting sites.

Prior research has shown that bat activity is higher in areas near water, which also happen to have high densities of insects (Grindal et. al., 1999). However, it may not be the case that bat activity in these areas is related only to high numbers of insects, when the availability of drinking water could be an equally important factor. For example, in previous years, Linker Spring has been an area noted for its abundance of bats as well as access to standing water. However, this year, water was not present at all and bat activity was exceptionally low. Is this conspicuous absence of bats due directly to the lack of water or to the lack of insects, which are absent because of the low water levels? Presumably, bats would prefer areas where there are both a high number of insects as well as accessible drinking-water. Further research is necessary to decide which factor is more important in determining bat activity.

At least two major flaws in our methods could have led to results which contrasted those of previous research. First, our crude technique for sampling insect abundance probably did not provide accurate information about the number of insects accessible to foraging bats. Our samples were taken between one and three meters above the ground; however, most bats tend to forage above this level, often above the canopy (Kalcounis et. al., 1999). In addition, bats forage mainly over water in riparian areas (Grindal et. al., 1999); however our samples were taken only over land *near* the water. In both cases, insect abundance where bats actually foraged could have been much different from where our samples were taken.

Second, we did not distinguish between navigational and feeding calls ("buzzes"). It was not possible to conclude whether detected bats were foraging or simply en route from roost to foraging site. Bats frequently travel long distances from prime roosting locations to prime foraging habitats (Brigham, 1991). If bats were commuting to foraging sites when they were detected, there should have been few feeding buzzes. Activity would therefore be unrelated to insect abundance. In future research, comparing only the number of feeding buzzes might reveal a direct relationship between bat-passes and insect abundance.

Although habitat type was not statistically significant related to bat activity, Table 3 suggests that at least one habitat type, riverine, showed a notable increase in bat activity. This conclusion supports prior research that bat activity is higher in riparian areas (Grindal et. al. 1999).

There are several possibilities for the high numbers of calls detected in the Maple River area. The site on the Maple River on August 3, where 129 calls were detected, was a short distance from a railroad bridge spanning the river. It is possible that bats were roosting beneath the bridge, which would account for the exceptionally high number of calls. Sites with lower numbers of calls might not have had roosting sites nearby.

It is also likely that this site, along with Lake Kathleen and Maple River Road (which had high numbers of calls as well), had high numbers of insects that we were unable to sample because they were over the water. To be certain, it would be beneficial to determine whether detected calls were foraging or navigational. However, the number of both foraging and navigational calls in riparian habitats has been found to be higher than in upland habitats (Grindal et. al., 1999). If a large percentage of calls that we detected were feeding buzzes, then this would support previous research (Grindal et. al., 1999).

While relative insect abundance may explain why sites on the Maple River received more calls than those in forested and disturbed areas, why did sites on Douglass Lake not detect an equally high number of calls? In addition, Douglass Lake sites generally contained less clutter than sites on the Maple River. One would expect this area to be frequented just as much, if not more than the Maple River area. Further research is necessary to determine the reasons for this difference.

Disturbed habitats demonstrated a slightly higher level of bat activity than forested areas (although not a statistically significant difference). Assuming bats forage predominantly in riparian areas, their use of other areas would be primarily for traveling. Therefore, their preference of disturbed over forested areas would depend more on navigational ease than insect abundance. Compared to cluttered forests, open habitats provide faster more efficient pathways to foraging grounds (Crampton & Barclay, 1998;

Kalcounis, et. al. 1999). However, it should be noted that while all bats may have habitat preferences, no species is restricted to only one habitat (Bell, 1980; Furlonger et. al., 1987).

The need to distinguish between different types of bat calls is essential for drawing conclusions from data collected using the Anabat system. This improvement alone would answer the reoccurring question of whether bats were actually foraging or just commuting in different areas. Also, in order to decipher the importance of riparian areas, it is vital to determine whether bats are more dependent on insect densities or drinking-water availability.

Technical difficulties with tape recorders and the Anabat system resulted in the loss of several nights of data which was especially detrimental considering our already small sample size. Because we were only concerned with *Myotis* spp., accurately identifying bats from their calls was very important. However, because many calls were truncated or distorted, these identifications may not have been made correctly. Also, due to a miscommunication, insects were collected twice on some nights while only once on others. As a result, numbers of insects from some nights were divided by two in order to maintain consistency.

Literature Cited

Bell, G. P. 1980. Habitat use and response to patches of prey by desert insectivorous bats. Canadian Journal of Zoology, 58: 1876-1883.

Brigham, R. M. 1991. Flexibility in foraging and roosting behavior by the big brown bat (*Eptesicus fuscus*). Canadian Journal of Zoology, 69: 117-121.

Kalcounis, M. C., et al. 1999. Bat Activity in the Boreal Forest: Importance of Stand Type and Vertical Striata. Journal of Mammalogy, 80(2): 673-782.

Crampton, Lisa H. & Robert M. R. Barclay. 1998. Selection of Roosting and Foraging Habitat by Bats in Different-Aged Aspen Mixed-wood Stands. Conservation Biology, 12(6): 1357-1358.

Furlonger, C. L., H. J. Dewar, and M. B. Fenton. 1987. Habitat use by foraging insectivorous bats. Canadian Journal of Zoology, 65: 284-288.

Grindal, S. D., et al. 1999. Concentration of bat activity in riparian habitats over an elevational gradient. Canadian Journal of Zoology, 77: 972-877.

Hickey, M. Brian C. & Alison L. Neilson. 1995. Relative Activity and Occurrence of Bats in Southwestern Ontario as determined by Monitoring with Bat Detectors. Canadian Field Naturalist, 109(4): 413-417.