# THE INFLUENCE OF TEMPERATURE ON WINTER ACTIVITY OF BIG BROWN BATS (*EPTESICUS FUSCUS*)

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Despite a history of public misconception, bats play vital ecological roles through plant pollination, seed dispersal, and pest management.[1] It is therefore necessary to understand the exogenous factors that affect the lives of these diverse mammals. One variable often positively correlated with activity, especially that of endotherms, is ambient temperature. Temperature is well-established as a predictor of bat activity and poses a challenge particularly for non-migratory bats such as Big Brown Bats (*Eptesicus fuscus*) that overwinter in cold climates, as lower temperatures result in greater thermoregulatory costs and fewer prey resources.[2] Therefore, winter activity would most likely be expected to occur during warmer nights; however, some research has reported flight activity by Big Brown Bats in southern Alberta during temperatures as low as -10.4°C.[3]

While many studies of bat activity have been conducted during warm months in temperate areas, few have taken place in the Canadian prairies during winter. Big Brown Bats remain on the prairies during winter and typically use older buildings in urban areas for hibernation.[4] Therefore, the objective of my study was to evaluate if flight activity occurs in older areas of Regina, and if so, whether temperature affects this activity.

## Methods and Materials

I deployed four SM4BAT-FS detectors (Wildlife Acoustics, Maynard, MA, USA) for acoustic monitoring of echolocation calls in the Cathedral subdivision of Regina, Saskatchewan from February 16 to March 8, 2020. Detectors were set up within 350 m of Wascana Creek with a minimum distance of 1 km between them. The detectors were programmed to record each individual bat pass, which I defined as a minimum of three pulses between 16 kHz and 120 kHz (0 dB gain, 16 kHz high filter on, 256 kHz sample rate, 1.5 ms minimum duration, and 50 ms maximum duration). Each recording began 30 minutes before sunset and ended 30 minutes after sunrise. The value for ambient temperature was obtained from The Weather Network Regina International Airport location and recorded during the hour following sunset.

I analyzed the recordings using Kaleidoscope Pro 5.1.9 and identified the recorded passes to the species level by comparing them with the North American reference library. I then assessed the relationship between the mean nightly number of recorded passes and ambient temperature using a Pearson correlation coefficient. Since each of the four sites were sampled multiple times, the potential for pseudoreplication exists within the correlational analysis.

## Results

I recorded 525 passes in total, all of which I identified as Big Brown Bats. All four sites had similar levels of activity, and all passes were recorded on nights with temperatures above 0°C, with the exception of -1.9°C (Figure 1). The night with the most recorded passes was also the warmest night of the study period at 11.5°C (Figure 1). I found a significant positive relationship between Big Brown Bat activity and ambient temperature ($r$ = .64, $p$ = .02).

## Discussion

The presence of Big Brown Bats in urban areas of the Canadian prairies is well-documented.[5-7] Therefore, my finding of their activity was not unexpected, although the function of winter flight remains unknown.

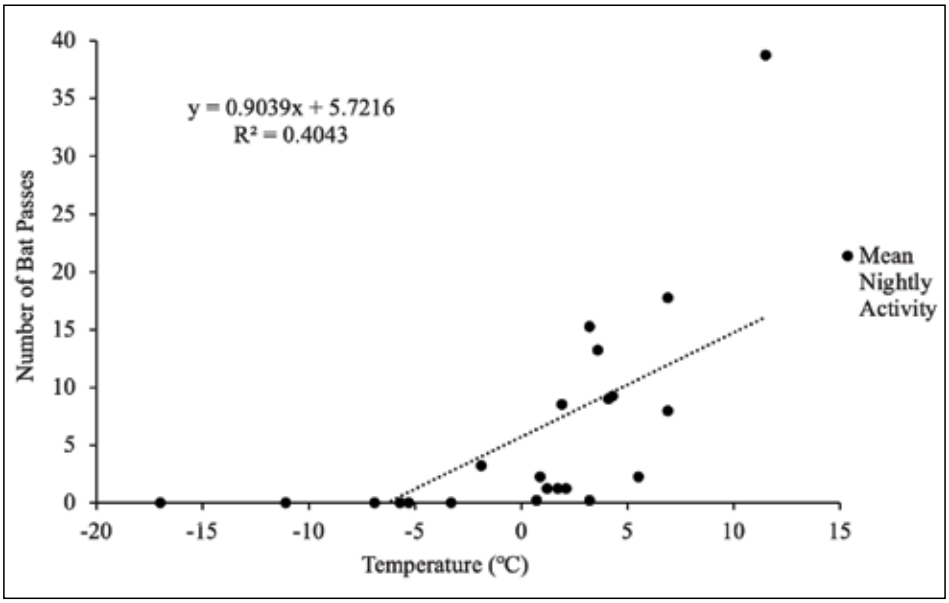


**FIGURE 1.** Mean number of Big Brown Bat passes per night relative to mean nightly temperature for Regina, February 16 – March 8, 2020. Data points indicate the mean nightly activity of four Wascana Creek sites.

Big Brown Bat (*Eptesicus fuscus*). Photo credit: Sherri and Brock Fenton.

While Big Brown Bats commonly hibernate in caves, abandoned coal mines, and deep rock crevices, this species also resides in buildings near their summer roosts, which suggests that the Regina locations observed during this study may be in close proximity to Big Brown Bat hibernacula.[8,4]

I also expected a correlation between activity levels and temperature based on existing literature, which has documented a positive relationship between these two variables.[9-10] While there are some reports of activity during temperatures as low as -10.4°C, further study is required to determine if bats in Regina fly at temperatures this low. I found that Big Brown Bats were more active during warmer nights, although this activity still occurred at relatively low temperatures with a mean of 0.2°C during the sampling period (Figure 1). However, the measure of temperature was not necessarily the same as inside a given roost, which tend to be several degrees warmer than the ambient temperature.[10]

A number of hypotheses exist for why bats arouse during hibernation, including dehydration, mating, foraging, and changes in temperature.[11-13] Since neither standing water nor insects are available during winter in Regina, this negates the possibility of activity due to dehydration or foraging. Based on my results, increased ambient temperature positively affects winter activity of Big Brown Bats in Regina; however, the cause of this activity remains a mystery.

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1. Kasso, M., and Balakrishnan, M. 2013. Ecological and economic importance of bats (Order *Chiroptera*). *International Scholarly Research Notices* 2013:1-9.

2. Meyer, G. A., Senulis, J. A., and Reinartz, J. A. 2016. Effects of temperature and availability of insect prey on bat emergence from hibernation in spring. *Journal of Mammalogy* 97(6):1623-1633.

3. Klüg-Baerwald, Gower, L. E., Lausen, C. L., and Brigham, R. M. 2016. Environmental correlates and energetics of winter flight by bats in southern Alberta, Canada. *Canadian Journal of Zoology* 94:829-836.

4. Whitaker, J. O., and Gummer, S. L. 1992. Hibernation of the big brown bat, *Eptesicus fuscus*, in buildings. *Journal of Mammology* 73(2):312-316.

5. Lausen, C. L. 2001. Thermoregulation and roost selection by reproductive big brown bats (*Eptesicus fuscus*) roosting in the South Saskatchewan River Valley, Alberta: rock-roosting and building-roosting colonies. Master's thesis, The University of Calgary, Calgary, AB.

6. Neubaum, D. J., Wilson, K. R., and O'Shea, T. J. 2010. Urban maternity-roost selection by big brown bats in Colorado. *Journal of Wildlife Management* 71(3):728-736.

7. Kurta, A., and Teramino, J. 1992. Bat community structure in an urban park. *Ecography* 15(3):257-261.

8. Nero, R. W. 1959. Winter records of bats in Saskatchewan. *Blue Jay* 17(2):78-84.

9. Wolbert, S. J., Zellner, A. S., and Whidden, H. P. 2014. Bat activity, insect biomass and temperature along an elevational gradient. *Northeastern Naturalist* 21(1):72-85.

10. Klüg-Baerwald, B. J., Lausen, C. L., Willis, C. K. R., and Brigham, R. M. 2017. Home is where you hang your bat: winter roost selection by prairie-living big brown bats. *Journal of Mammology* 98(3):752-760.

11. Lausen. C. L., and Barclay, R. M. R. 2006. Winter bat activity in the Canadian prairies. *Canadian Journal of Zoology* 84(8):1079-1086.

12. Boyles, J. G., Dunbar, M. B., and Whitaker, J. O. 2006. Activity following arousal in winter in North American vespertilionid bats. *Mammal Review* 36(4):267-280.

13. Avery, M. I. 1985. Winter activity of pipistrelle bats. *Journal of Animal Ecology* 54(3):721-738.