Mexican free-tailed bat (*Tadarida brasiliensis*)

Thermoregulation in Microchiroptera: a Study of a Resident Population of Tadarida brasiliensis at Massacre Cave, Dominica, West Indies

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Abstract

The purpose of this study was to evaluate the temperature regulation strategies among Microchiropterans on Dominica. Data were collected on the Mexican free-tailed bat, Tadarida brasiliensis, at the cave at Massacre, Dominica, West Indies on two occasions, once during roosting and the other after emergence. Bats were weighed, morphometrics taken, and species and sex determined. Body temperature was taken using a small animal quick read anal thermometer. The data were analyzed using Pearson correlation coefficients and a t-test derived in the statistical software package StatView. We hypothesized that the body temperature of bats would reach a minimum during periods of inactivity (while roosting), and that circling behaviors before emergence would function to raise body temperature. However, our data show that body temperature is on average 3.1°C higher while roosting.

Introduction

Temperature regulation in small endotherms, such as bats and rodents, requires a large energy expenditure. This is caused by a high level of heat loss due to a large surface to volume ratio. Thus, it is critical for small mammals to balance the metabolic costs of maintaining their body temperature at levels often much greater than ambient temperature with the metabolic gains of peak enzyme efficiency achieved at higher temperatures.

The cave at Massacre was chosen because it was easy to access bats directly in their roosting site. The cave is located on a rock and cobble beach approximately 150 meters south of the rocky outcropping called Rodney's Rock. The mouth of the cave opens parallel to the Caribbean shoreline about five meters from the tidal zone. Previous work from the Dominica Study Abroad class in 2001 had indicated that the colony occupying the cave was primarily *Tadarida brasiliensis*, although some *Molossus molossus* were present.

Tadarida brasiliensis is one of the most conspicuous and abundant bats on many islands of the Antilles, including Dominica (Genoways et all., 2001). It is an insectivorous bat in the suborder Microchiroptera, in the family Molossidae. It is a small dark brown bat having an average wingspan of 225 millimeters (Evans and James, 1997). It is characterized by a tail free of the uropatagium and a wrinkled upper lip.

Materials and Methods

For comparison of average temperatures, bats were collected while roosting and after emergence. A 24-hour period was allowed between data collection to adjust for disturbance, which might effect temperature readings.

Bats were collected from roosting sites using an insect net. The net was removed from its handle and placed beneath a tight cluster of bats. The bats were then plucked individually and placed into the net. Upon disturbance the other bats began diving into the net. Twenty-seven bats were collected in this manner. Individual bats were immediately removed from the net, their body temperature and weight taken, and released upon processing. Morphometrics and ectoparasites were taken from nine T. brasiliensis.

On the following day bats were captured after emergence using a twelve-meter mist net placed across the mouth of the Massacre cave. The net covered all but approximately two to three meters on either side and about one meter above the top of the net. The bats began emerging at dusk, approximately 6:30 pm. Thirty-nine bats were removed from the mist net by 7:05 pm, and thirty-two were placed into socks to be processed. Seven of the thirty-nine bats were released because of a shortage of socks to place them in, and later one T. brasiliensis was released due to injury. Twenty-five of the remaining thirty bats were T. brasiliensis, and five were M. molossus. Temperature, weight, and sex were taken on the twenty-five T. brasiliensis.

The mass and temperature data collected on T. brasiliensis was analyzed using StatView, a computer program for statistical analysis. Relationships between the mass

and temperature for both roosting and emerging bats were examined, as well as the relationship between temperatures before and after emergence.

Results

The relationship between the mass and temperature of roosting bats was analyzed through the use of a correlation coefficient within StatView. The correlation coefficient and probability value (P-value) were found to be (Table 1.1):

r= 0.142
p=0.484

These results indicate a highly insignificant correlation between the mass and temperature of roosting bats. The correlation coefficient and p-value for bats after emergence were found to exhibit a slightly higher correlation, though the relation was also found to be insignificant (Table 1.2). The values are as follows:

r=0.364
p=0.081

StatView was also used to determine if there was any difference in mean body temperature of T. brasiliensis before and after emergence (Table 1.1, 1.2). A t-test was performed yielding the results:

t= 13.5
DF= 49.0
P<0.001

This data show a highly significant difference between the roosting temperatures and those taken after emergence. The average body temperature after emergence was found to be 3.081°C cooler than that of roosting bats. All data obtained from T. brasiliensis is included in Appendix 4.

Discussion and Conclusions

Our initial hypothesis was that the roosting temperature of bats would be lower than the temperature after emergence. We expected the bats to lower their temperature during inactivity to conserve energy. However, the data obtained at the Massacre cave clearly do not support this hypothesis.

Our data show that there is a very similar pattern in the distribution of individual temperatures before and after emergence (Appendix 3), but the results show the opposite of our initial hypothesis. There is on average, a 3.081°C drop when T. brasiliensis emerges from its roosting site.

This may be due to the fact that the temperature of the bats inside the cave may be elevated by their close contact in tight huddles within crevices. The bats' temperature decrease after emergence may be due to the lack of shared heat while foraging in open air.

Appendix 1

Table 1.1 Roosting Tadarida brasiliensis
Collected: June 9, 2004 at 5:00pm

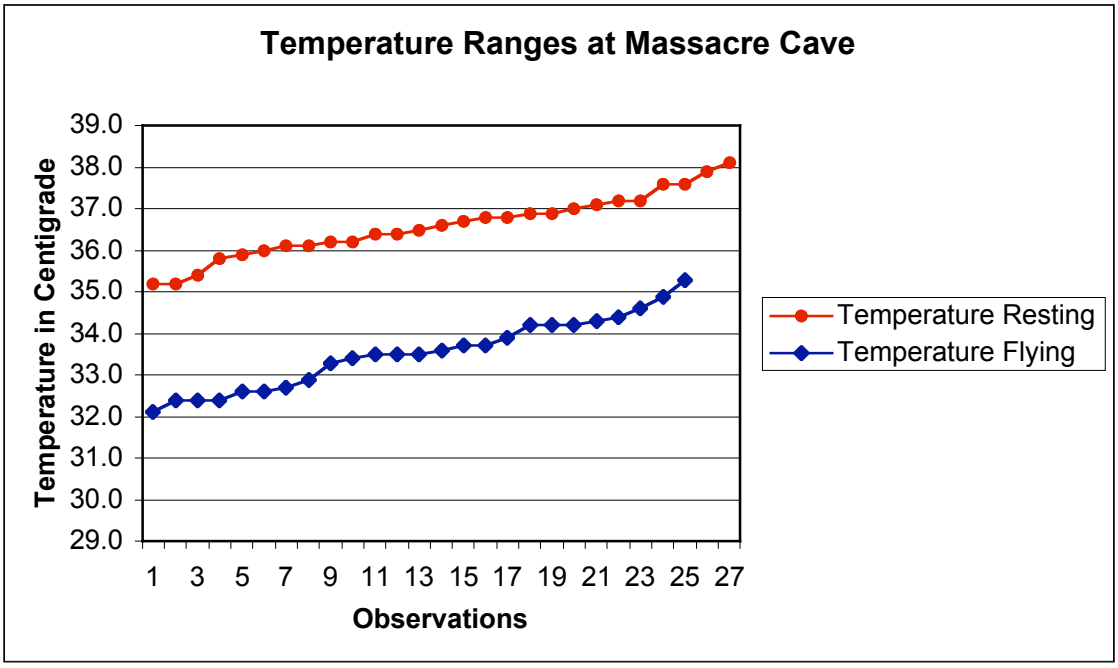
Sex	Weight	Temperature
F	10.0	35.2
F	9.0	36.0
F	8.0	37.6
F	9.0	37.0
F	9.0	37.6
F	9.0	36.8
F	9.0	36.9
F	10.0	37.2
F	10.0	37.1
F	10.0	36.1
F	9.0	38.1
F	8.0	35.2
F	9.0	37.2
F	8.0	36.5
F	8.0	35.9
F	9.0	36.2
F	10.0	36.4
F	9.0	36.1
F	9.0	36.4
F	9.0	36.2
F	9.0	35.4
F	10.0	37.9
F	8.0	36.6
F	9.0	36.7
F	8.0	35.8
F	8.0	36.9
F	9.0	36.8
Average	9.0	36.6

Appendix 2

Table 1.2 Tadarida brasiliensis after emergence
Collected: June 10, 2004 at 7:05pm

Sex	Weight	Temperature
M	13.0	34.4
M	9.0	32.4
F	10.0	34.3
M	9.0	35.3
F	10.0	32.6
M	9.0	34.2
F	9.0	33.5
F	9.0	32.4
F	8.0	32.1
F	9.0	32.9
F	9.0	33.7
F	9.0	33.4
F	8.0	32.6
F	8.0	32.4
F	9.0	33.5
F	11.0	33.9
F	9.0	34.9
F	10.0	33.6
F	10.0	33.3
F	9.0	32.7
F	9.0	34.2
M	9.0	33.5
F	9.0	34.6
F	9.0	33.7
Average	9.3	33.5

Appendix 3



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Appendix 4

B= Before Emergence
E= After Emergence

Correlation Coefficient
Hypothesized Correlation = 0

	Correlation	Count	Z-Value	P-Value	95% Lower	95% Upper
Weight-B, Resting Temp	.142	27	.700	.4839	-.252	.495

Correlation Coefficient
Hypothesized Correlation = 0

	Correlation	Count	Z-Value	P-Value	95% Lower	95% Upper
Weight-E, Emergence Temp	.364	24	1.747	.0806	-.046	.669

Unpaired t-test for Body Temp
Grouping Variable: Category for Body Temp
Hypothesized Difference = 0

	Mean Diff.	DF	t-Value	P-Value
Temp-B, Temp-E	3.081	49	13.497	<.0001

Group Info for Body Temp
Grouping Variable: Category for Body Temp

	Count	Mean	Variance	Std. Dev.	Std. Err
Temp-B	27	36.585	.581	.762	.147
Temp-E	24	33.504	.754	.869	.177

Works Cited

Evans, Peter G.H., and Arlington James 1997. Dominica: Nature Island of the Caribbean. Faygate Printing, Sussex.

Genoways, Hugh H., Robert M. Timm, Robert J. Baker, Carleton J. Phillips, and Duane A. Schlitter 2001. Bats of the West Indian Island of Dominica: Natural History Areography, and Trophic Structure. Special Publications, Museum of Texas Tech University.

Cover Picture can be found at:

Mexican free-tailed bat, *Tadarida brasiliensis*, Texas Parks and Wildlife. Accessed June 16, 2004. http://www.tpwd.state.tx.us/nature/wild/mammals/bats/species/mex_freetail.htm