

**Activity of American Pikas (*Ochotona princeps*) with respect to temperature along  
an elevational gradient.**

**Andrea N. Chavez REU 2006**

**Abstract.** This study investigates the effects of temperature on the activity levels of a small diurnal North American lagomorph, the American pika, *Ochotona princeps*. By recording temperature in talus habitat (broken down rock fields) and duration of pika activity above talus surface, aim was to determine a correlation between pika activity levels and air temperature. This study bears importance to the understanding of island biogeography of American pikas, and how temperature can affect their mobility in a metapopulation structure.

## **INTRODUCTION**

North American pikas, *Ochotona princeps* (Order: Lagomorpha), are small diurnal mammals that inhabit talus fields (rock slides on mountain slopes) at high elevations (Huntly, et al. 1986). These small mammals are restricted to cool, moist microhabitats in regions with short summers, freeze-free periods and long winters (Beever, et al. 2003). Many studies have suggested that pikas are adapted to and rely on cool temperatures for survival. The cover of the talus habitat provides this as well as shelter and protection from predators. Pikas display a disjunct distribution due to the patchiness of talus fields, and provide a classic example of metapopulations. They can also be considered an island species because they inhabit and are restricted to talus habitat and high alpine mountain tops.

Pikas can be considered an island species in two different ways. First, they live in isolated talus fields on mountain slopes. Pikas are restricted to the rock cover of talus fields because they provide shade from the hot sun. Since pikas must graze meadows outside the cover of talus rocks (Roach, et al. 2001), warmer temperatures at low elevations may limit the amount of time they spend foraging (Huntly, et al. 1986). Because pikas are physiologically restricted to cool conditions, long distances (300m) between suitable habitats act as dispersal barriers particularly at low elevations (Hafner and Sullivan 1995). Alternatively, at high elevations where temperatures are lower, pikas occupy wider ranges of their fundamental habitat (Smith 1974a).

Pikas can also be considered an island species because they live on mountain tops. If pikas are physiologically sensitive to warm temperatures, they become restricted to higher elevations, and can go nowhere but up in elevation. As global temperatures continue to increase, temperatures on mountain tops will also increase, and pikas, along with other temperature-limited montane mammals, will be left with no choice but to contract their ranges to higher elevations.

A recent study has suggested that 7 out of the 25 historically documented populations of pikas in the Great Basin appear to have been extirpated in the span of only a few decades in response to a number of anthropogenic causes including climate change (Beever, et al. 2003). Many other small montane mammals require the cool moist habitats that are found on high alpine mountains. As global temperature continues to increase, it is possible that these species may exhibit similar elevational shifts in their distribution.

In this study I investigated the relationship between air temperature above talus surfaces and activity of pikas. It is important to monitor other populations of pikas in

order to determine whether the trend that has been seen in the Great Basin is widespread. Monitoring the temperatures at which pikas are active can help provide a better idea of what their thermal limits are, and perhaps provide insight into the future of these animals as global temperatures continue to increase.

The objective is to monitor pika activity with respect to temperature, and determine whether there is a correlation between temperature and the amount of time spent active in certain temperatures. This study offers three hypotheses for the relationship between pika activity and temperature. First, if pikas are sensitive to warm temperatures (27°C), then they will spend more time in temperatures below 27°C than they will in temperatures above 27°C. This hypothesis is constant across all three sites. Second, the low site will see the least amount of pika activity due to its larger percentage of warm temperatures in relation to the other sites. In concurrence with this hypothesis, the high site will see the most activity due to its lower percentage of warm temperatures throughout the day, and the middle site will fall somewhere in between. Third, warm midday temperatures at all three sites will yield lower amounts of pika activity. Concurrently, morning and evening temperatures will yield more activity.

## **METHODS**

### ***Sites***

There were three observational sites along an elevational gradient, all of which were located in talus fields along Copper Creek Trail, headed northeast out of Gothic, Colorado, townsite of the Rocky Mountain Biological Laboratory. Talus fields consist of

broken down mountain rock, the result of many years of rock slides and erosion. The sites were dubbed low (3050m), middle (3350 m) and high (3650 m) according to their elevations. An elevational gradient was chosen in order to sample varying temperatures throughout the day.

### ***Observations***

To determine whether there was a correlation between temperature and activity, air temperature was recorded as pika activity was observed. Each of the three sites were observed for pikas during three periods of the day – morning (07:00-10:00), midday (10:00-15:00), and evening (15:00-19:00). Every time a pika was observed outside of cover (above the rocks) the temperature, time of day and the duration of the pika's activity were recorded. Type of activity was also recorded in order to make additional inferences.

### ***Temperature***

Temperature was recorded using iButtons. Both temperatures above and below talus surface were recorded to determine the difference between thermal conditions outside and under talus cover. A simultaneous three-day sample of temperatures at all three sites was also taken as a method of comparison. This sample was used to display the differences in temperature at differing elevations over the same time interval.

### ***Replication***

Part of the original procedure was to get three replications of observations during each time period at each site, or more if weather permitted. Unfortunately it did not. Late afternoon and evening observations proved difficult due to daily lightning storms in the area. Other complications arose as iButtons were stolen by animal suspects, and data was

lost. Due to these obstacles, data was either not obtained from all sites for the duration of all observational periods or was lost. Therefore, three replications of each site for each period was not accomplished.

## **RESULTS**

These data were analyzed in three different ways. First I did a correlation analysis between temperature and time. I looked at a two day period of time when temperature loggers recorded data at all three sites simultaneously in order to get an accurate representation of the daily temperature fluxes at each site. I found that temperature and time were highly correlated (average correlation values dropping negative signs: site1/day1 0.874; site 1/day2 0.874; site 2/day1 0.907; site 2/day2 0.952). I was unable to determine whether there was a correlation between temperature and time of day at the high site because the simultaneous temperature logger for that site was stolen. Since, there was a strong correlation between temperature and time of day, the two were considered one variable. It is referred to as temperature throughout this article.

The second analysis I performed compared the presence of active pikas and temperature. Whether or not a pika was present above the surface of the talus was plotted against the corresponding temperature at which it was active. This analysis allowed me to determine at what temperatures pikas are active. At the low site, temperatures ranged from 9.5°C to a high of 40°C between the hours of 7:00 and 19:00. Pikas were active between 19.5°C and 38°C. There was no correlation between temperature and number of pikas active at this site ( $R\text{-squared} = 0.0054$ ). At the middle site, temperatures ranged from 9.0°C to a high of 37.5°C within the same time span. Pikas were active between 10°C and 37.5°C. There was a positive correlation between temperature and number of

pikas active ( $R\text{-squared} = 1.144$ ). At the high site, daily temperatures ranged from 9.0°C to a high of 30°C. Pikas were active between 10°C and 30°C.

The third analysis I performed compared the duration of activity above talus surface with temperature. This analysis found that there was no correlation between duration of activity and temperature.

## **DISCUSSION**

In the analysis between time of day and temperature, I found the two to be highly correlated, however, they were not completely correlated. This suggests the possibility that temperature is partially independent of the time of day. It is a possibility that pikas function according to a circadian rhythm, and they simply come out during certain times of the day regardless of air temperature. To tease apart which is more responsible for patterns of pika activity, a much larger sample size should be evaluated and each site replicated more.

In the analysis comparing the number of active pikas with temperature, I found that they are active at most temperatures throughout the day ranging from about 10°C to 38°C. I was unable to determine at what temperatures they spend most of their time active due to a small and disjunct sample size. The summer months in which this study was conducted were particularly rainy, and I was unable to collect during thunderstorms due to the danger of lightning. I also excluded periods of rain from the study to avoid precipitation as a confounding variable. This weather factor had a large effect on the amount of time I had to observe, especially in the sites that were more difficult to get to (middle and high sites).

Another topic of investigation is the effect of cloud cover and precipitation on pika activity levels since they have a large effect on the temperature of an area. This presents a question for further research. There were several times when I had to leave observational sites before observations were complete due to lightning and rain. During many of those times, pikas were heard and seen above talus cover as it was raining. Although I was unable to determine what temperatures pikas spend most of their active time in, there is one important thing to note. At all three sites, there were pikas active up until the maximum temperatures of the day. This suggests that they are able to utilize time in warm temperatures. This study bears further investigation with larger sample sizes. Reconstruction of data collection method is advised.

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**Name: Andrea N. Chavez**

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**Research Experience for Undergraduates (REU) 2006**

**Mentor: George Aldridge**