Daily and seasonal activity patterns of the pika in southwestern Montana
by Robin Lee Kistler Moore

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Biological Sciences
Montana State University

Abstract:
Diurnal and nocturnal activity patterns of pikas were studied by visual observations and radio telemetry during summer and fall 1984 and winter 1985, in Gallatin Canyon, Montana. Inferences were made on the extent of meadow feeding and haypile feeding during the winter, and seasonal changes in behavioral patterns were related to winter survival strategies. Pika body temperature and ambient temperature were recorded during the fall. Total pika activity was significantly greater in fall than during winter; however, there were no significant differences between summer-fall and summer-winter activity. There were np significant differences in mean proportion of activity throughout the 24-hour periods, although pikas showed small, consistent peaks of activity during the morning and late afternoon in all seasons. There was no significant correlation between pika activity and ambient temperature or between pika body temperature and ambient temperature. Throughout the seasons, pikas spent a major portion of theip time inactive below the talus surface and feeding above the surface. The proportion of time spent meadow feeding did not vary significantly throughout the seasons. More time was spent in haypiling, perching, and social behavior during summer than fall. The proportion of time spent feeding and inactive below the surface varied significantly with time of day during summer and fall but not in winter. During periods of inclement weather in the fall, nocturnal meadow feeding was significantly reduced. During winter nights with temperatures below 17° C, there was a decrease in meadow foraging excursions and an increase in haypile utilization, but these differences were not significant.

The amount of nighttime activity did not vary significantly between seasons and consisted primarily of meadow feeding. Moon phase did not have any measurable effect on the amount of nocturnal pika activity throughout the seasons. During the winter the greatest amount of time was spent inactive below the surface. The intensity of activity was less than in summer and was confined primarily to meadow foraging and activity near the haypile (haypile feeding).

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APPROVAL

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Robin Lee Kistler Moore

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date 17 April 1987

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ABSTRACT

Diurnal and nocturnal activity patterns of pikas were studied by visual observations and radiotelemetry during summer and fall 1984 and winter 1985, in Gallatin Canyon, Montana. Inferences were made on the extent of meadow feeding and haypile feeding during the winter, and seasonal changes in behavioral patterns were related to winter survival strategies. Pika body temperature and ambient temperature were recorded during the fall. Total pika activity was significantly greater in fall than during winter; however, there were no significant differences between summer-fall and summer-winter activity. There were no significant differences in mean proportion of activity throughout the 24-hour periods, although pikas showed small, consistent peaks of activity during the morning and late afternoon in all seasons. There was no significant correlation between pika activity and ambient temperature or between pika body temperature and ambient temperature. Throughout the seasons, pikas spent a major portion of their time inactive below the talus surface and feeding above the surface. The proportion of time spent meadow feeding did not vary significantly throughout the seasons. More time was spent in haypiling, perching, and social behavior during summer than fall. The proportion of time spent feeding and inactive below the surface varied significantly with time of day during summer and fall but not in winter. During periods of inclement weather in the fall, nocturnal meadow feeding was significantly reduced. During winter nights with temperatures below $-17^{\circ}C$, there was a decrease in meadow foraging excursions and an increase in haypile utilization, but these differences were not significant. The amount of nighttime activity did not vary significantly between seasons and consisted primarily of meadow feeding. Moon phase did not have any measurable effect on the amount of nocturnal pika activity throughout the seasons. During the winter the greatest amount of time was spent inactive below the surface. The intensity of activity was less than in summer and was confined primarily to meadow foraging and activity near the haypile (haypile feeding).

INTRODUCTION

Pikas are small lagomorphs found in Eurasia and western North America. The North American pika, Ochotona princeps, is limited to talus slopes and rockslides in boreal and alpine areas throughout the Sierra Nevada-Cascade and Rocky Mountain chains. They are herbivorous and feed on vegetation in meadows adjacent to rockslides. Like other lagomorphs, pikas are coprophagous and produce two types of feces, one of which is reingested (Severaid 1955, Johnson and Maxell 1966). Pikas have a low-energy diet of leaves and stems, and they do not easily accumulate fat. They do not switch to higher energy food items (seeds, fruits, insects) in late summer as do some hibernating small mammals such as ground squirrels (Iverson and Turner 1972, Hansen and Johnson 1976, Zegers and Williams 1977, Michener 1979, Jones, Jr. et al. 1983). Pikas do not hibernate but maintain high body temperatures and remain active all year (Krear 1965, MacArthur and Wang 1973, Markham and Whicker 1973). Because pikas must depend on adequate year-round food supplies, winter is a critical period, and pika behavior and physiology must be adapted to their need to feed frequently.

Pikas devote a significant portion of their time to hay gathering and are selective in the plants they gather relative to availability (Johnson and Maxell 1966, Millar and Zwickel 1972a, Elliot 1980, West 1980). They also maintain territories centered around their haypiles (Broadbooks 1965, Krear 1965, Kawamichi 1976). The haypiles are used during winter; however, most pikas do not store enough hay to serve as an exclusive winter food source (Hayward 1952, Millar and Zwickel 1972a). It is assumed that pikas must forage to some extent beneath the snow during winter. Millar and Zwickel (1972a) and Conner (1983) inferred that haypiles serve as supplemental food supplies during harsh weather that would inhibit active foraging. More information is needed to clarify the significance of haypiling behavior (Millar and Zwickel 1972a, Smith 1981).

Pikas are easily observed when they are active on the rock surface during the day. Considerable information on their natural history is available (Severaid 1955, Krear 1965, Broadbooks 1965), and a few studies have quantified their activity patterns (Barash 1973, Smith 1974b, Conner 1983). Most studies of pika activity have been limited to observations of pikas active on the rockslide surface. However, their rockslide habitat provides excellent cover and restricts visual observations of activity when the pikas

are below the rock surface. Snow cover further inhibits visual observations.

Summer and fall studies have shown that pikas feed actively during the day (Hayward 1952, Severaid 1955, Broadbooks 1965, Krear 1965). Anecdotal reports of nocturnal feeding activity (Severaid 1955, Smith 1974b) and calling (Dalquest 1948, Krear 1955, Smith 1974b) have been made, but little other evidence of night activity has been reported.

No quantitative observations have been made of pika subnivian activity, although a few observations of pika winter activity have been reported. Kawamichi (1968) observed that the Himalayan pika, Ochotona roylei, had very small haypiles and maintained activity both on the surface and in complicated burrow systems in the snow. The Japanese pika, Ochotona hyperborea, constructed large haypiles, and winter activities were confined beneath the snow cover (Kawamichi 1969). Markham and Whicker (1973) reported that pikas remained active all winter and tunneled extensively beneath the snow in colonies maintained in enclosures near Fort Collins, Colorado. Conner (1983) conducted one of the few field studies of pika winter activity, but he was limited to visual observations of pikas active on windswept talus surfaces.

This study utilized radiotelemetry to expand observations of pika activity to include nocturnal and

winter periods. The objectives of this study were:

(1) To provide quantitative information on diurnal and nocturnal activity patterns of pikas during summer, fall, and winter;

(2) To examine daily and seasonal variation in the duration of time spent in various activities (feeding, haying, investigation, social behavior, perching, and activity below surface);

(3) To draw inferences from these observations on the extent of meadow feeding and haypile feeding during the winter;

(4) To relate seasonal changes in behavioral patterns to winter survival strategies.

Data were also gathered on the relationship of pika body temperature to ambient temperature in the fall and the influence of weather on nocturnal activity patterns.

To fulfill these objectives, pikas were radio collared during summer and fall 1984, and winter 1985, at two sites in the lower Gallatin Canyon, Gallatin County, Montana. Quantitative data on activity, including activity during the night and under rock or snow cover, was gathered by systematic monitoring throughout 24-hour periods. Radio transmitters designed to measure body temperature were implanted in animals and monitored during the fall.

SITE DESCRIPTION

Populations of pikas were studied at two sites in the lower Gallatin Canyon approximately 40 and 48 kilometers (km) south of Bozeman, Gallatin County, Montana (Figure 1). The sites were at an elevation of 1,707 meters (m) and were located near the Cascade Creek and Greek Creek drainages. These sites were chosen because they afforded easy access for gathering winter data.

The lower section of the Gallatin Canyon from the Big Sky Ski Resort northward is quite narrow and typical of an unglaciated stream-cut canyon. In this northern section of the canyon, the Gallatin River has cut into Precambrian basement rocks which account for essentially all of the exposed outcrops, including the talus slides at both study sites. These loose, large, angular rocks are primarily banded gneisses containing black or dark-green amphibole bands and pink bands of quartz, feldspar, and silica-rich minerals. These talus rocks are often cut by thin black diabase dikes containing mainly pyroxene, plagioclase, and white pegmatite veins (McMannis and Chadwick 1964, Fritz 1985).

The following climatological data were recorded at a National Oceanic and Atmospheric Administration (NOAA)

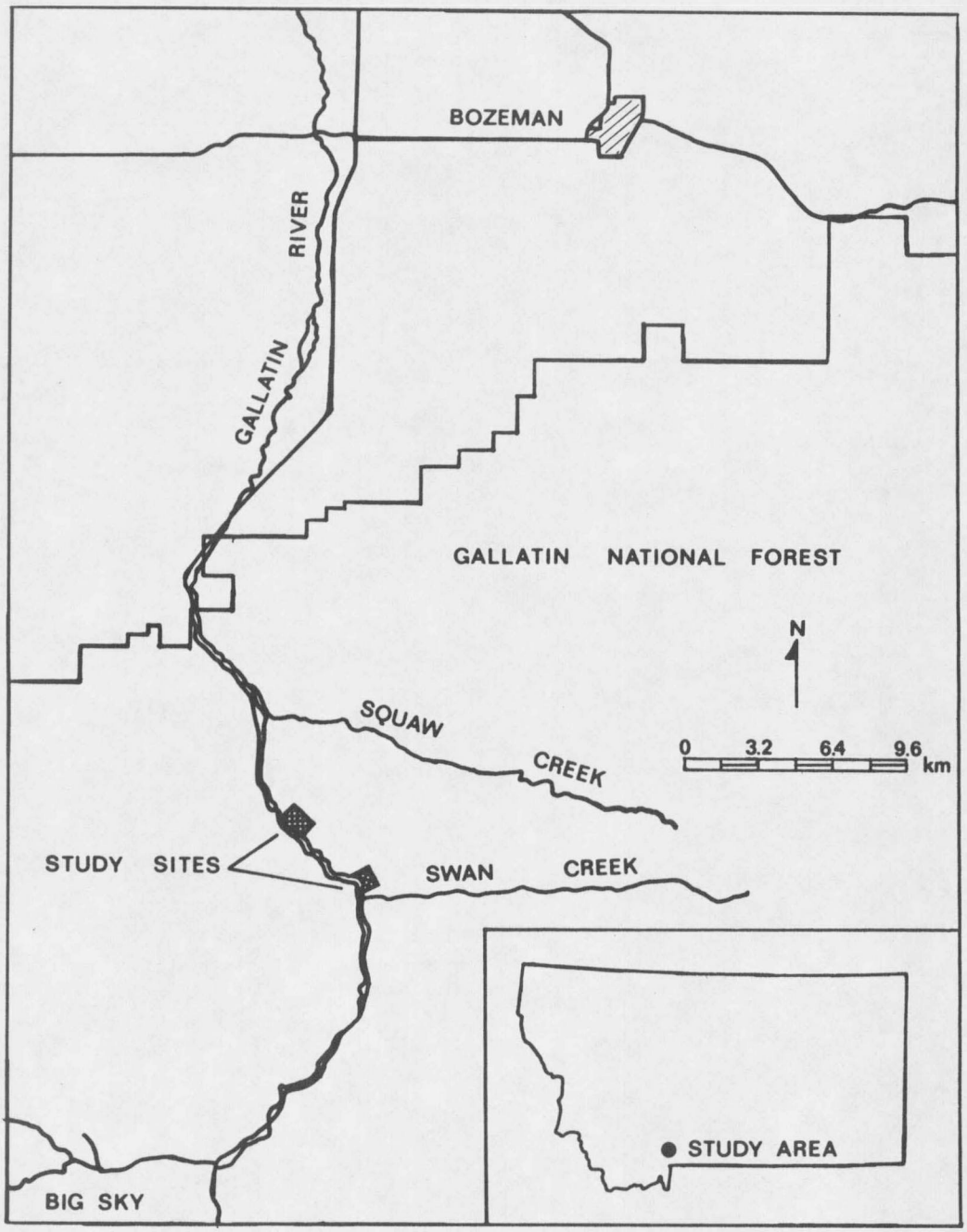

FIGURE 1. Map of study area.

reporting station south of the study site near Big Sky at an elevation of 2,012 m. During August 1984, temperatures ranged from -1.1°to 29.4°C with a mean temperature of 14.5° C. Total precipitation was 10.3 centimeters (cm). In the fall (September and October 1984), temperatures ranged from -15 to 26.7°C with a mean temperature of 4.7°C. Monthly precipitation averaged 5.3 cm with a maximum snow depth of 20.3 cm by the end of October. During January and February 1985, temperatures ranged between -37.2 C and 8.3°C with a mean temperature of -9.4°C. Monthly precipitation averaged 2.4 cm with a maximum snow depth of 66 cm by the end of February. During these winter months, the rockslide and meadow maintained a complete snow cover with only the largest rock crevices remaining open.

Vegetational characteristics at both study sites are similar. Both rockslides have primarily western exposures and are at the base of steep slopes with adjacent rocky cliffs. The surrounding area is forested with a mixture of Douglas fir (Pseudotsuga menziesii) and lodgepole pine (Pinus contorta). The understory contains Rocky Mountain maple (Acer glabrum), chokecherry (Prunus virginiana), and ninebark (Physocarpus malvaceus). Open areas at the base of the rockslides contain a variety of grasses, forbs, and shrubs. Dominant plants which were eaten by pikas include red raspberry (Rubus idaeus), currant and gooseberry (Ribes

spp.), wild rose (*Rosa* sp.), alder (*Alnus* sp.), thimbleberry (*Rubus parviflorus*), yarrow (*Achillea millefolium*), goldenrod (*Solidago* sp.), yellow clover (*Melilotus officinalis*), fireweed (*Epilobium angustifolium*), and sagebrush (*Artemisia* sp.), as well as a variety of grasses (*Poa*, *Stipa*, *Agropyron*, *Phleum*, *Elymus*, and *Agrostis*).

METHODS

Trapping and Radiotelemetry Techniques

In July and August 1984, five adult pikas (four females and one male) were trapped with Havahart live traps (46 by 13 by 13 cm) baited with fresh vegetation. Fresh willow (*Salix* sp.) was the most successful bait. Traps were set near haypiles and along commonly used routes to adjacent feeding areas. Traps were checked once or twice each day as exposure to the midday sun was stressful to the pikas. Upon capture, pikas were transported back to the lab and maintained in a metal mesh holding cage (41 by 25 by 30 cm). The cage contained a 30-cm black cardboard mailing tube for shelter. The animal was provided with fresh damp vegetation, apple, and a small dish of water. The pikas were held for a maximum of 8-24 hours before being returned to the study site.

For handling, pikas were placed in a denim sack with a zipper at one end and drawstring at the other. They were sedated with an intraperitoneal injection of Nembutal (18.5 milligrams/kilogram) which was 26.4% of the dosage used by MacArthur and Wang (1973). The pikas were weighed, sexed (Duke 1951), and marked with colored metal ear tags. Four

of the pikas were equipped with radio collars containing SM-1 transmitters (AVM Instrument Company, Ltd.) and mercury (Hg)-625 batteries encased in acrylic. Radios weighed 8-9 grams (g) each. A Telemetry Systems RT-20A receiver with a three element hand-held Yagi antenna was used to monitor radio signals. These four animals were followed from August through early November. Three animals lost their collars, and two of these collars were replaced during this 4-month interval. By early November all radio collars had been lost.

Animals were retrapped and equipped with new collars in order to complete winter observations. Two pikas were trapped during the first week of January 1985. Alfalfa hay was used for bait and seemed to be readily taken by the pikas. One pika had been radio collared previously, and the other pika had been used earlier for a body temperature transmitter implant experiment. One of these lost its collar in mid-January. The other pika was followed through February when it subsequently lost its collar.

Activity Observations

Activity and location of the radio collared animals were monitored during the summer (28 July - 16 September) and fall (17 September - 26 October) of 1984 and the winter (9 January - 9 February) of 1985. The designation of the