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# A Field Study of Telemetry-Recording of The Body Temperature in Wild Mongolian Pikas

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**Abstract:** The pika inhabiting in cold zone or in high mountains is thought to be adapted to cold as well as high-altitude environment. We have reported pika's high body temperature (39.6℃), high metabolism and poor heat loss ability such as poor panting, small ear pinnae and lack of thermal salivation. In this study, we measured the body temperature of wild pikas (*Ochotona daurica*) with a telemetry device in their natural burrows in Mongolia. Two pikas captured at Undur Dov were implanted with transmitters in the abdominal cavity under anesthesia, and were returned to the own habitat. The mean body temperatures of the pikas were 39.65℃ and 39.96℃, though the data were limited to a short period of less than one day. The present results in wild pikas support pika's high body temperature in our previous studies.

*Key words:* Pika, Telemetry, Body temperature, Mongolia

## INTRODUCTION

The pika lives in cold zone or in high mountains and attracts the attentions as an animal model of cold adaptation (Kawamichi, 1985; Yang *et al,* 1988; Yang, 1990) as well as high-altitude adaptation (Sakai, 1988; Sakai *et al,* 1994). Previously, we have reported pika's high metabolic rate, high body temperature (39.6℃), heat intolerance and poor heat loss ability such as poor thermal panting, small ear pinnae and lack of thermal salivation (Kosaka *et al.,* 1985; Yang *et al.,* 1988; Yang, 1990; Matsumoto *et al.,* 1992). In those studies, however, the body temperature had been measured in the laboratory raised pikas held in the hands. In July 1994, we collected the pikas in Mongolia and brought them to Japan for the breeding of the pika as a new laboratory

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animal. During this expedition to Mongolia, the present field study was performed. In order to confirm our previous results of pika's high body temperature, the body temperature was measured in wild pikas in their own burrows by using a telemetry device in Mongolia.

## Materials and Methods

The radio transmitter (TM-disc with 850MAH lithium battery, Mini-Mitter Co., Inc., OR, USA) and a citizens band transceiver (TRC-244, Tandy Corporation, TX, USA) of which transmit function was disabled were used in this study. The transmitter (18mm in diameter, 34mm in length and 13.5g in weight) sends the pulses corresponding with the temperature. We could hear a periodic "cheep" or "click" with each pulse of the transmitter by using a receiver. When the transmitter was buried 50cm beneath the ground, the signal was received more than 50m in the open field. As shown in Fig. 1, there was a linear correlation between the temperature and the pulse frequency in the range of temperature between 35℃ and 42℃ in each of the two transmitters. By measuring the pulse rate of the implanted transmitter and using the calibration curve, the deep body temperature of the subject animal is monitored.

The two pikas (*Ochotona daurica*), weighing 150g and 183g respectively, captured at Undur Dov (about 40km west of Ulaanbaatar, about 1350m above sea level), Mongolia, were used in this study. In a tent just beside the habitat, a transmitter was implanted into the peritoneal cavity of each pika under ketamine hydrochloride (35mg/kg, i.p.) anesthesia. After the surgical procedure, the pikas were allowed to recover from the anesthesia in the cages, and they eventually escaped from the cages before being released.

Ambient temperature and relative humidity were measured with digital humidity meter (HT-410, SOAR Corporation, Nagano, Japan) at Undur Dov for three consecutive days (July 28−30, 1994).

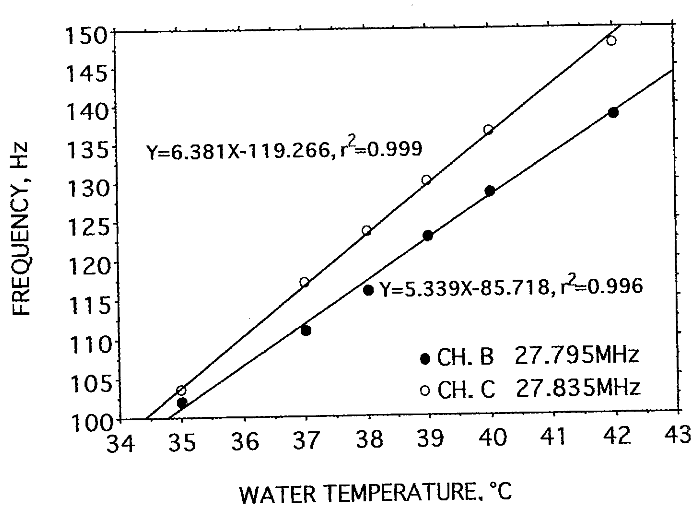


Fig. 1. Calibration of the transmitters. There was a linear correlation between water temperature and pulse frequency in the range between 35℃ and 42℃ in each transmitter.

## RESULTS

The terrain around Undur Dov is a wide-opened steppe area with small elevations and the land is sparsely covered by the grass of less than 20cm in height. One of the steppe-dwelling pikas, *Ochotona daurica,* inhabits in this area. Their burrows are mainly found along a depression between small ridges on the slide, where the plants are relatively dense and the wind is not strong. The burrow was composed of an under-ground network with several entrances.

One pika was captured at 20:00 on July 26 (pika C) with a trap and the other at 10:00 on July 27 (pika B) around the same burrow. Both pikas recovered from anesthesia within a few hours and escaped from the cages before being released. The body temperature was monitored for 14 hours in pika C and for 7 hours in pika B, respectively (Fig. 2). The mean body temperatures after the recovery from the anesthesia were 39.65℃ and 39.96℃ in pika C and pika B, respectively. In the pika C the body temperature just after the implantation was low, because the abdominal cavity was washed with sterilized saline before closing with sutures. In the next afternoon on July 28, we unfortunately found that the pika C was dead (the pulse rate was very low comparable to the ambient temperature). The strongest signal from the pika was recorded 70m distance from where it was captured. Moreover, no signal was picked up from the pika B. Another two pikas were also noted on July 28 around the burrow where the first two pikas had been captured.

The changes in ambient temperature and relative humidity at Undur Dov from July 28 to July 30 were shown in Fig. 3. It is the hottest month in July and mean ambient temperature is 16.7℃ at Ulaanbaatar. During daytime, the ambient temperature varied from 13℃ to 22℃ and the relative humidity was around 40% except rainy days. Even in July, the ambient temperature dropped to 4.2℃ in the early morning (July 29) probably due to the massive radiant heat loss from the earth surface to the clear, dry sky at night.

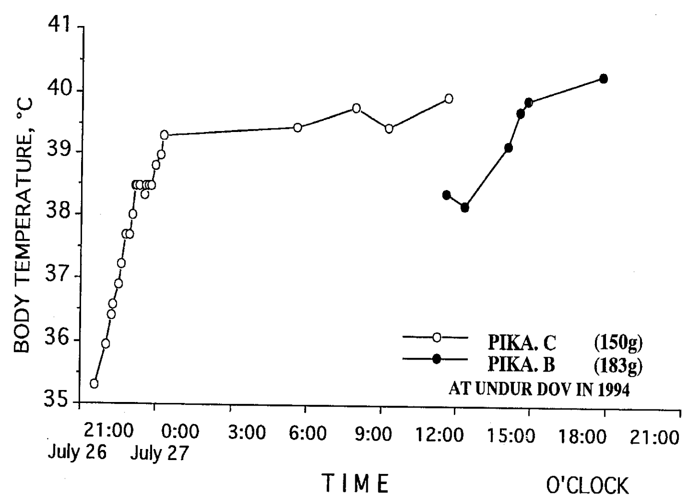


Fig. 2. Body temperature in wild Mongolian pikas recorded with telemetry devices in their natural burrows. Pika C escaped from the cage around 0:00 on July 27, and pika B around 13:00 on July 27. The mean body temperature of the two pikas after the recovery from the anesthesia was 39.65℃ and 39.96℃, respectively.

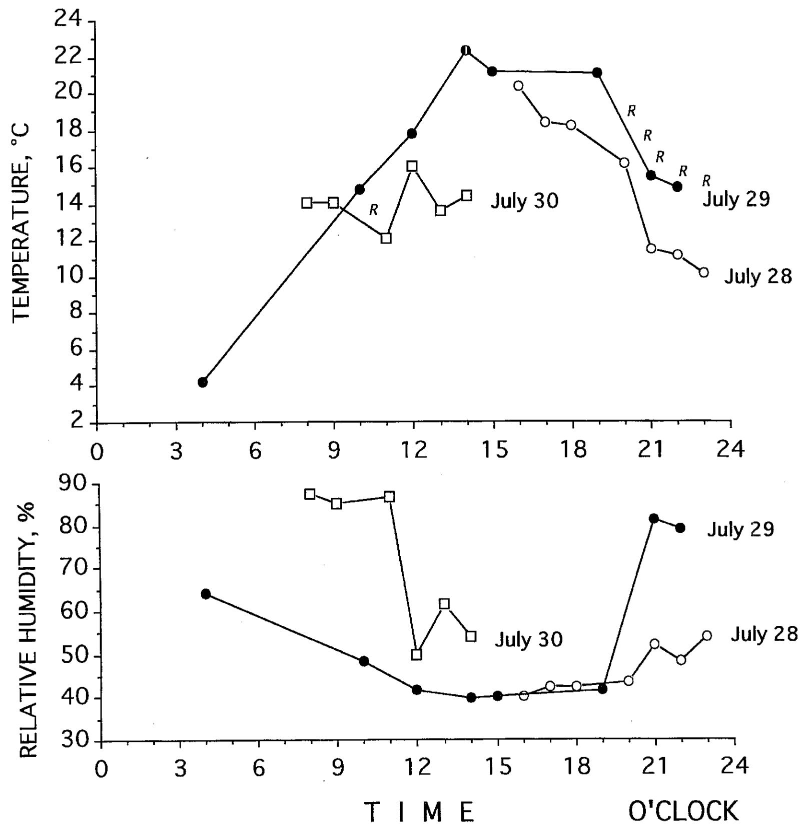


Fig. 3. Ambient temperature and relative humidity at Undur Dov, Mongolia from July 28 to July 30 in 1994. *R* indicates rain.

## Discussion

We have reported pika's high body temperature, 39.6±0.17℃ (n=15, *Ochotona rufescens*) at 22℃ of ambient temperature (Kosaka *et al.*, 1985), 39.58±0.38℃ (n=9, *O. rufescens*) at 26℃ of ambient temperature (Matsumoto *et al.*, 1992), 39.8±1.2℃ (n=17, *O. curzoniae*), 39.6±0.3℃ (n=6, *O. curzoniae*), 39.6℃ (n=2, *O. cansus*) in China (Kosaka *et al.*, unpublished), and 39.8±0.7℃ (n=5, *O. curzoniae*) in Tibet (Sakai, 1994). In the former two studies, the pikas raised in the laboratory were used, and the wild pikas were studied in the field in the latter studies. The body temperature was measured in the pikas held in the hands, therefore, the influence of the restraint stress on the body temperature was not eliminated. It is well known that the stress induces hyperthermia in rats (Singer *et al.*, 1986). By using a telemetry device, the body temperature can be monitored in the animal without any influence of restraint stress under conscious condition.

In this study, the body temperatures of the two wild pikas freely moving in their own natural burrow were recorded by using telemetry devices and were found to be as high as 39.65℃ and 39.96℃, respectively. The present results, though the data were limited to a short period of less than one day, provide the supportive evidence of pika's high body temperature reported in our previous studies.

Another purpose of this study was to disclose circadian variation of the body temperature in pikas. The pikas have been reported to be diurnal, most active at dawn and dusk (Kawamichi, 1985), mainly diurnal (Broadbooks, 1965), active in day and night, especially in dawn and dusk (Haga, 1960) after the field observation, and nocturnal (Kosaka *et al.,* 1988) after the recording of locomotor activity in the laboratory. Telemetry recording of the body temperature is a good tool to investigate the circadian activity. Unfortunately, we failed in this purpose, because the transmitter was too large for the pikas used in this study. The transmitter is recommended to be less than 5% of the body weight, however, it happened to be 7.4% and 9.0% in this study. The Mongolian pikas (*O. daurica*) were considerably smaller than our expectation based on the data of Afghan pikas (*O. rufescens rufescens*) which weighed approximately 250g (Puget, 1973; Yang, 1990). One pika was dead and the signal from another pika was lost after a few days. It was speculated that the pika's activity was diminished after the implantation of a heavy transmitter and that the pika might be captured by the predator and be taken out of the range where the transmitter signal received. The smaller transmitter should be used for Mongolian pikas, according to our experience.

One pika cruised 70m, which distance is in agreement with the previous observation that the pika's cruising radius is about 30 to 40m (Haga, 1960). As most steppe-dwelling pikas have been described as living together in a family, we encountered at least four pikas in a burrow.

In winter it is about −20℃ to −30℃ at Ulaanbaatar. Actually, it was recorded to be at 4.2℃ even in July. Interestingly, we found in Mongolia that the pikas live next to the marmots which are the hibernators. The other hibernators such as chipmunks, golden-mantled squirrels and ground squirrels are also the neighbors of the pikas in North America (Broadbooks, 1965). The pikas do not hibernate (Haga, 1960; Dawson, 1981), therefore, the pikas should develop characteristic strategies to survive in the cold, other than hibernation. They live in the burrows or in the shelter among rocks and boulders, and hoard grasses for winter food. Thus the pikas are thought to be ecologically adapted to the cold environments.

It is considered that the pikas appeared in the cold area in the Pliocene and expanded southward during cold glacial periods, and retreated to the high mountains during warm interglacial periods in the Pleistocene. The current distribution of the pika ranges widely from low to extremely high altitude, about 10 to 6,100m above sea level (Sakai, *et al.,* 1988), indicates that not the altitude but the temperature is a limiting factor in the distribution of pikas. The pikas prefer low temperature and the temperature of their burrow is very low even in summer, about 12℃ to 14℃ (Haga, 1960). The ratio of ear surface area to body surface area is very small (Yang, 1990) and thermal panting is poor (Yang *et al.,* 1988) compared to rabbits, though heat radiation through the ear pinnae and thermal panting are major heat loss responses in rabbits. Furthermore, the pikas do not spread saliva on their body surface when exposed to heat (Matsumoto *et al.,* 1992). Body temperature and metabolic rate in pikas are higher than rabbits (Kosaka et al., 1985). Thus due to poor heat loss responses and high metabolism the pika is heat intolerant and adaptive to the cold. The pika is considered to be adapted to the cold not only ecologically but also through autonomic thermo-regulatory mechanisms.

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