Journal of Arid Environments 125 (2016) 52–55

Contents lists available at ScienceDirect

Journal of Arid Environments

journal homepage: www.elsevier.com/locate/jaridenv

Short communication

Caught basking in the winter sun: Preliminary data on winter thermoregulation in the Ethiopian hedgehog, *Paraechinus aethiopicus*, in Qatar

Mohammad A. Abu Baker [a, *], Nigel Reeve [b], Ivan Mohedano [a], April A.T. Conkey [c], David W. Macdonald [d], Nobuyuki Yamaguchi [a, **]

[a] Department of Biological and Environmental Sciences, College of Arts and Sciences, Qatar University, P.O. Box 2713, Doha, Qatar
[b] 2 Paxton Gardens, Woking, GU21 5TR, UK
[c] Caesar Kleberg Wildlife Research Institute and Department of Animal, Rangeland, & Wildlife Sciences, Texas A&M University —Kingsville, Kingsville, TX 78363, USA
[d] Wildlife Conservation Research Unit, Department of Zoology, The Recanati-Kaplan Centre, University of Oxford, Tubney House, Tubney, Oxford, OX13 5QL, UK

ARTICLE INFO

Article history:
Received 17 February 2015
Received in revised form
17 May 2015
Accepted 5 October 2015
Available online 17 October 2015

Keywords:
Basking
Desert
Erinaceidae
Ethiopian hedgehog
Heterothermy
Temperature sensor

ABSTRACT

Biologists focus on thermoregulation of desert mammals in terms of how they minimize heat gain, and put less effort on how they maximize heat gain during the cooler months. Heat gain may contribute to significant energy savings in desert mammals when the ambient temperature is substantially lower than body temperature. We investigated winter thermoregulation in free-ranging Ethiopian hedgehogs, *Paraechinus aethiopicus*, during winter using radio-telemetry in Qatar. Hedgehog temperatures (*Animal* T_a) were significantly higher than ambient temperatures (T_a) throughout the day, the difference was more extreme during the mid-day. We observed several hedgehogs basking with their radio-tags exposed to direct sunlight. We suggest that basking is beneficial for the hedgehog's thermoregulation in the desert where plenty of solar radiation is available with few predators. This is the first report of basking in the subfamily Erinaceinae.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Heterothermy is an important strategy for reducing energy requirements during thermoregulation in various endothermic mammals and birds (McKechnie and Mzilikazi, 2011). Although this strategy is often discussed in association with hibernation in colder climates, heterothermy seems to be fairly widespread among mammals in warmer arid environments (Geiser and Körtner, 2010; McKechnie and Mzilikazi, 2011). However, available information is far from satisfactory, especially outside the arid regions of Australia and southern Africa (Mzilikazi et al., 2002; Warnecke et al., 2008; Scantlebury et al., 2010; Warnecke and Geiser, 2010).

Thermoregulation is a challenge for organisms living in arid environments where most small mammals avoid daytime activity to minimize water loss and hyperthermia. However, during cooler winter, exposing the body to direct sunlight reduces energy requirements directed to endogenous heat production (Porter and Gates, 1969; Chappell et al., 1978). Basking is a common behavior of thermoregulation in many reptiles but has been reported for several mammalian species as well (Brown and Downs, 2007; Geiser and Körtner, 2010).

The Ethiopian hedgehog, *Paraechinus aethiopicus*, is a small insectivorous mammal that inhabits the desert regions of North Africa, the Arabian Peninsula, and Southwest Asia (Harrison and Bates, 1991). The species is nocturnal throughout the year, and may enter bouts of hibernation or reduce their activity levels during the coldest months of the year (Dmi'el and Schwarz, 1984; Al-Musfir and Yamaguchi, 2008). As a well-adapted desert-dweller, *P. aethiopicus* is a good model species to study thermoregulation of mammals in a desert environment. Yet, little is known about its ecology and behavior. Its small size, wide distribution and

* Corresponding author.
** Corresponding author.
E-mail addresses: abubakerma@gmail.com (M.A. Abu Baker), yamaguchi@qu.edu.qa (N. Yamaguchi).

http://dx.doi.org/10.1016/j.jaridenv.2015.10.002
0140-1963/© 2015 Elsevier Ltd. All rights reserved.

abundance, and most importantly; living in arid environments under extreme daily and seasonal fluctuations in weather conditions, all make this species well suited for conducting studies on thermoregulation. For desert hedgehogs, employing mechanisms of thermoregulation and hibernation/torpor are rewarding if it produces energy savings by reducing the demands during winter. Furthermore, collecting data on its life history contributes greatly to the advances in mammalian heterothermy, among other adaptations to the desert environments (McKechnie and Mzilikazi, 2011).

During the initial stages of our ongoing research on thermoregulation and hibernation in free-ranging Ethiopian hedgehogs in Qatar, we monitored daily patterns of hedgehog temperatures, activity, and behavioral thermoregulation. We came across a possible proactive thermoregulation behavior that had not been previously described for hedgehogs. In this short communication, we present preliminary data and observations from the study.

2. Materials and methods

Adult hedgehogs were hand-captured during the night at an agricultural research station owned by the Ministry of Environment in northern Qatar (25°49′21.36″N, 51°19′57.52″E, Fig. 1) during the winter (January) of 2013–2014. Animals were individually color-marked, sexed, and weighed upon capture. Temperature-sensing VHF radio-transmitters (Biotrack Ltd., Wareham, UK) were glued to the backs of ten adults (7 males and 3 females) following the methods described in Warwick et al. (2006) as part of a hibernation study (Abu Baker et al., unpublished). Each radio tag was equipped with a temperature sensor on its underside, sited close to the animal's body when attached. The tag produced a signal with a repetition rate that varies according to temperature. Corresponding temperatures (to the accuracy of ±2 °C) were calculated following the manufacturer's instructions (Biotrack Ltd., Wareham, UK). This monitoring was not designed to measure the body temperature of the animal (T_b) accurately, but was appropriate to monitor the ambient temperature immediately surrounding the animal or its microclimate (*Animal* T_a) to study activity, habitat utilization, and behavior (Kenward, 1982).

We monitored hourly signal rates using hand-held flexible three element Yagi aerials and Sika receivers (Biotrack Ltd., Wareham, UK) within four days: 02, 03, 13, and 16 January 2014. We also located animals' daytime shelters by radio-tracking, and observed their behavior whenever we could do so without disturbing them. A radio-transmitter (placed in the shade at ground level) and a hand-held weather tracker (Kestrel 3000, Pocket Weather Meter, Nielsen-Kellerman, Boothwyn, USA) were used to monitor the ambient temperature (*Control* T_a and T_a, respectively). We used ANOVA to test the effect of day, ambient temperature (T_a), and sex on mean animal temperatures (*Animal* T_a). We compared T_a to *Control* T_a using a t-test. All statistical analyses were carried out using SYSTAT 13 (SPSS Inc. Chicago, USA). This research was approved by the Institutional Animal Care and Use Committee, Qatar University (reference number: QU-IACUC 008/2012).

3. Results

We recorded 420 temperature points from each of 10 free-ranging adult hedgehogs within the four days of manual monitoring. During the monitoring, T_a varied from 15.4 °C to 25.1 °C. Mean ambient temperature (T_a) was significantly different among the four days (ANOVA: $F_{3, 88} = 16.9$, $P < 0.001$), this is mainly due to variability of day-time temperatures (Fig. 2).

The *Animal* T_a varied significantly by day (ANOVA: $F_{2, 267} = 14.96$, $P < 0.001$) and was significantly higher than T_a throughout the day (ANOVA: $F_{1, 267} = 47.59$, $P < 0.001$, Fig. 2). The difference between *Animal* T_a and T_a was significantly larger during daytime than nighttime (ANOVA: $F_{1, 390} = 16.43$, $P < 0.001$). Mean *Animal* T_a was highest during the mid-day hours between 11:00 and 13:00 pm (highest 73.94 °C, mean ± standard error 31.1 ± 2.5 °C) and lowest just before sunrise and around sunset (lowest 11.15 °C, 18.3 ± 0.5 °C, Fig. 1). Although mean *Animal* T_a for females was slightly higher than that for males, the overall difference was not significant (ANOVA: $F_{1, 267} = 0.21$, $P = 0.65$). Between sunrise and sunset, *Control* T_a was significantly lower than T_a (t-test: $t = 11.62$, $df = 41$, $P < 0.001$. *Mean* $T_a = 18.6$ °C, $n = 42$, mean *Control* $T_a = 17$ °C, $n = 42$).

Daytime resting places were located within grasses (3 occasions), underneath leaf litter (5), inside bushes (3), under piles of dead trees (4), or within thickets of shrubs and trees (15). Although most animals were hard to spot under the thick vegetation, we succeeded in observing five males and two females during daytime on nine occasions as they were basking in the sun (completely or partially within their resting site). The animals were observed in a rolled-up position with their back to the sun (except for one occasion when a female was lying flat on her back, exposing her belly to the sun). These postures produced high *Animal* T_a during those times due to direct exposure of the tag to the sun (Fig. 3).

4. Discussion

Our study is the first investigation of behavioral thermoregulation in free-ranging Ethiopian hedgehogs. During the cold winter, the hedgehogs experienced large daily fluctuations in ambient temperatures and used a combination of nighttime foraging and daytime proactive basking as a mechanism of thermoregulation to reduce their energy requirements. *Animal* T_a, which is affected by the hedgehog's microclimate as well as its body temperature, was higher than T_a and *Control* T_a throughout the day (Fig. 2). The hedgehog's endogenous heat may have raised the *Animal* T_a slightly during the night due to increased activity of this nocturnal species. However, the difference between *Animal* T_a and T_a (and *Control* T_a) was larger during mid-day while the animals were resting. *Animal* T_a reached over 60 °C on three occasions during the mid-day hours which is around double the hedgehog's normal body temperature of c. 34 °C (Shkolnik and Schmidt-Nielsen, 1976). Such high *Animal* T_a was caused by the hedgehog (and thus the tag) being exposed to direct sunlight while the animals were basking.

A growing body of literature in recent years has strongly suggested that basking contributes in substantial energy savings for heterothermic, as well as normothermic mammals in arid regions in African and Australia, including rock hyrax, *Procavia capensis*, striped mouse, *Rhabdomys pumilio*, African ice rat, *Otomys sloggetti*, rock elephant shew, *Elephantulus myurus*, Giles' planigale, *Planigale gilesi*, fat-tailed dunnart, *Sminthopsis crassicaudata*, stripe-faced dunnart, *Sminthopsis macroura*, fat-tailed antechinus, *Pseudantechinus macdonnellensis*, and Alpine ibex, *Capra ibex ibex* (Chappell and Bartholomew, 1981; Macdonald, 1992; Mzilikazi et al., 2002; Schwaibold and Pillay, 2006; Brown and Downs, 2007; Geiser and Körtner, 2010; Signer et al., 2011; Warnecke and Geiser, 2010). As the single largest constraint on energy savings is the cost of rewarming to normothermy, it is beneficial for heterothermic mammals to utilize solar energy for rewarming, which is readily available in arid environments even during cold periods (McKechnie and Mzilikazi, 2011). Also, whether they are rewarming from torpor or not, many small mammals may bask to overcome nocturnal hypothermia and to reduce the costs of metabolic heat production especially when they are thermally stressed and forage is scarce and of low quality (Schwaibold and Pillay, 2006).

We suggest that basking behavior is beneficial for Ethiopian

Download English Version:

https://daneshyari.com/en/article/4392792

Download Persian Version:

https://daneshyari.com/article/4392792

Daneshyari.com