Body temperatures of *Sceloporus anahuacus* from a montane zone of northeastern Estado de México, Mexico.

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Information on the thermal ecology of lizards is important because our ability to understand the potential for climate change to affect the future distributions of species depends in part on our understanding of current relationships of species with their thermal environments. Given that a recent study has suggested the potential for major negative impacts of climate change on the abundance and distribution of Mexican lizards (Sinervo et al., 2010), the more information we can gather on temperature relationships of lizards the better we might be able to predict such changes. The body temperatures and temperature relationships of lizards in the genus *Sceloporus* are among the best studied of any genus of lizards, and information on numerous species has been published. However, there are still species for which no published information on body temperatures and temperature relationships are available. One such species is *Sceloporus anahuacus*. *S. anahuacus* is relatively unstudied, but it has been observed perched on rocks or the ground along road sides or near forests (Smith & Lemos-Espinal, 2005) and it is found in pine forests between 2800 and 3600 m in the mountains around Mexico City (Ramírez-Bautista et al., 2009). Here we report on the body temperatures of *S. anahuacus* from Isidro Fabela, Estado de México, Mexico. In particular, we consider the effects of environmental temperatures, body size, sex and reproductive condition, and microhabitats on body temperatures.

MATERIALS AND METHODS

We conducted the study in Isidro Fabela (19° 32' 41" N, 99° 29' 20" W and 3200 m elevation), northeastern Estado de México, Mexico. Mean annual temperature and precipitation are 12°C and 800 mm, respectively. Plant species include *Pinus montezumae*, *Pinus* sp., *Stipa ichu*, *Muhlenbergia* sp., *Festuca* sp., *Outeloa* sp., *Bachaeris conferta*, and *Senecio praecox*, principally (Rzedowski, 2006).

We captured lizards by hand or noose between 0930 and 1330 h. Once captured, we recorded sex, reproductive condition in females (by abdominal palpation), snout vent length (SVL, to the nearest 1 mm), body (T_b; cloacal temperature, to the nearest 0.2°C), air (T_a; bulb in the shade, 3.0 cm over the substrate occupied by the lizard, to the nearest 0.2°C), and substrate temperature (T_s; bulb in the shade on the substratum occupied by the small lizard, to nearest 0.2°C) using a quick-reading thermometer (Shultetheis, Miller Weber Inc., interval 0-50°C, 0.2°C precision). We also recorded each lizard's position with regard to solar insolation as being completely exposed to sun, in shade, or cloudy day. Lizards that needed a major effort to capture (> 1 min.) were excluded from

	T_b (°C)	T_a (°C)	T_s (°C)
Males (N = 36)	30.50 ± 0.18	20.48 ± 0.35	20.31 ± 0.40
Non-gravid females (N = 50)	30.32 ± 0.20	20.16 ± 0.36	19.40 ± 0.35
Gravid females (N = 33)	32.13 ± 0.26	20.81 ± 0.47	20.72 ± 0.41

Table 1. Mean body temperature (T_b), air temperature (T_a), and substrate temperature (T_s) of male, non-gravid female, and gravid female *S. anahuacus*. Means are given ± 1 SE.

	T_b (°C)	T_a (°C)	T_s (°C)
Sunny (N = 79)	31.07 ± 0.18	20.88 ± 0.24	20.47 ± 0.24
Sun/Shade Mosaic (N = 30)	30.63 ± 0.23	19.61 ± 0.52	19.29 ± 0.56
Shaded (N = 10)	30.06 ± 0.51	19.48 ± 0.84	18.92 ± 0.61

Table 2. Mean body temperature (T_b), air temperature (T_a), and substrate temperature (T_s) of S. *anahuacus* found in sunny, sun/shade mosaic, and shaded microhabitats. Means are given ± 1 SE.

temperature records. We used only one observation for each lizard.

RESULTS AND DISCUSSION

Mean T_b was 30.88 ± 0.14 °C (N = 119). Mean T_a was 20.44 ± 0.22 °C (N = 119). Mean T_s was 20.04 ± 0.23 °C (N = 119). Body temperature was significantly related to T_a (N = 119, r^2 = 0.18, P < 0.0001; $T_b = 25.47 + 0.26T_a$). Body temperature also increased with T_s (N = 119, r^2 = 0.14, P < 0.0001; $T_b = 26.24 + 0.23T_s$). It thus appears that environmental temperatures are important in the body temperatures of *S. anahuacus*; however, the relatively low amounts of variation in body temperature that were explained by environmental temperatures suggest that these lizards may be able to regulate their body temperatures to some extent.

Body temperature was not related to SVL (N = 119, r^2 = 0.017, P = 0.15). Our results are consistent with the failure of all previous studies that have examined the potential effects of lizard size on T_b in *Sceloporus* to find such an effect (*S. horridus*, Lemos-Espinal et al., 1997b; *S. jarrovi*, Smith & Ballinger 1994; *S. malachiticus*, Vial 1984; *S. ochoterenae*, Lemos-Espinal et al., 1997; *S. siniferus*, Lemos-Espinal et al., 2001). It thus appears that body size likely plays little, if any, role in body temperatures in *Sceloporus*, but additional studies are needed to confirm this.

Body temperature differed among males, non-gravid females, and gravid females (Table 1; $F_{2,116}$ = 20.06, P < 0.0001), with gravid females having signficiantly warmer T_{bs} than both males and non-gravid females (Tukey HSD, P < 0.05). However, mean T_a did not differ between these three groups (Table 1; $F_{2,116}$ = 0.70, P = 0.50), but T_s did (Table 1; $F_{2,116}$ = 3.26, P = 0.042). Our observation that gravid females had a higher mean T_b than males or non-gravid females is different from previous studies that have found that pregnant or reproductive females had lower mean T_{bs} (*S. grammicus*, Andrews et al., 1997; *S. jarrovi*, Smith & Ballinger, 1994) or did not have a different mean T_b than males or non-reproductive females (*S. bicanthalis*, Andrews et al., 1999; *S. gadoviae*, Lemos-Espinal et al., 1997c). Taken together, these results suggest that reproductive condition can influence body temperatures in *Sceloporus*, but that the nature of this influence varies among species, but our database is too small to draw any conclusions as to why.

Most lizards were observed in sun microhabitats

(79; 66.4%), followed by mosaic microhabitats (30; 25.2%). Relatively few of the lizards were observed in shaded microhabitats (10; 8.4%). Microhabitat did not affect T_b (Table 2; $F_{2,116} = 2.50$, $P = 0.09$). However, mean T_a was highest in sunny microhabitats (Table 2; $F_{2,116} = 3.89$, $P = 0.026$), as was T_s (Table 2; $F_{2,116} = 0.20$, $P = 0.82$). *Sceloporus* can thermoregulate by shuttling (Bowker et al., 1986), which may help explain the constant T_{bs} and variable T_a and T_s among microhabitats in *S. anahuacus*.

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