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Body temperatures of two species of *Aspidoscelis* from Zapotitlán Salinas, Puebla, Mexico

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Abstract. We report on body temperatures and thermal relationships of two previously unstudied species of *Aspidoscelis* (*A. parvisocia, A. sackii*) from Mexico. The two species had similar mean body temperatures (*A. parvisocia*: 37.2°C; *A. sackii*: 38.3°C). Body temperatures in *A. parvisocia* were affected by both air and substrate temperatures, whereas in *A. sackii* body temperature was only affected by substrate temperature. *Aspidoscelis parvisocia* were most often found in sun/shade mosaic microhabitats, whereas *A. sacki* were most often found in sunny microhabitats. In both species, lizards using different microhabitats had significantly different body temperatures. In both species, body size did not affect body temperature. In general, it appears that these two species are similar in their thermal ecology to other previously studied *Aspidoscelis.*

Keywords. *Aspidoscelis parvisocia, Aspidoscelis sackii*, body temperature, microhabitat use, temperature relationships

Introduction

The genus *Aspidoscelis* ranges from Costa Rica northward through most of the United States (Wright, 1993; Reeder, Cole and Dessauer, 2002). These lizards are found in a variety of habitats, but are frequently associated with open areas within the macrohabitat in which they are found (e.g. Casas-Andreu and Gurrola-Hidalgo, 1993; Bateman, Chung-MacCoubrey and Snell, 2008). *Aspidoscelis* are active foragers (see Anderson, 1993; Cooper et al., 2001; 2005), engaging in frequent movements throughout their habitat to find and pursue food. Given their use of open areas in their habitat, and their active foraging habit, thermal relations could be very important for their performance.

The body temperatures and thermal relationships of lizards in the genus *Aspidoscelis* are relatively well-known, with considerable information being available for some species (e.g. *A. sexlineatus, A. tigris*; Table 1). In general, these lizards have relatively high body temperatures (Table 1). Here we report on the body temperatures and thermal relationships of two previously unstudied species of *Aspidoscelis* (*A. parvisocia, A. sackii*) from Mexico.

Materials and Methods

We conducted the study in Zapotitlán Salinas Valley (18°84' N, 97°29' W; 1600 m elevation), in Puebla, Mexico. Mean annual temperature and precipitation are 21°C and 400 mm, respectively. Plant species include several cacti (*Nebouxbamia tetetzo*, *Cephalocereus* spp.), mesquite trees (*Prosopis laevigata*), and pata de elefante trees (*Beucarnea gracilis*) (Rzedowski, 2006).

We captured lizards by hand or noose. Once captured, we recorded snout vent length (SVL, to nearest 1 mm), body mass (to nearest 0.2 g, using a spring balance), body (T_b; cloacal temperature, to nearest 0.2°C), air (T_a; bulb in the shade, 3.0 cm over the substrate occupied by the lizard, to nearest 0.2°C), and substrate temperature (T_s; bulb to the shade on the substratum occupied by the small lizard, to nearest 0.2°C) using a quick-reading thermometer (Shultetheis, Miller and Weber Inc., interval 0-50°C, 0.2 precision). We also recorded each lizard's position with regard to solar insolation as being completely exposed to sun, in shade, or in a sun/shade mosaic. Lizards that needed a major effort to capture (> 1 min.) were excluded from temperature records. We used only one observation for each lizard.

Results

Aspidoscelis parvisocia

Mean T_b was 37.16 ± 0.40 °C (N = 64). Mean T_a was 32.82 ± 0.44 °C (N = 64). Mean T_s was 34.22 ± 0.47 °C (N = 64). Body temperature increased with T_a (N = 64, $r^2 = 0.60$, $P < 0.0001$; $T_b = 14.04 + 0.70T_a$). Body temperature also increased with T_s (N = 64, $r^2 = 0.60$, $P < 0.0001$; $T_b = 14.96 + 0.65T_s$). Body temperature was

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Table 1. Range of published mean body temperatures (Tb) of several species of *Aspidoscelis*.

Species	T_b (°C)	Reference
A. ceralbensis	40.0 - 40.7	Soulé, 1963; Brattstrom, 1965
A. communis	36.2	Casas-Andreu and Gurrola-Hidalgo, 1993
A. deppii	40.0 – 41.2	Kennedy, 1961; Vitt, Caldwell and Durtsche, 1993
A. dixoni	39.9	Walker et al., 1991
A. exsanguis	38.5 – 39.9	Medica, 1967; Schall, 1977; Bowker, 1993
A. flagellicauda	39.9	Stevens, 1980
A. gularis	38.3 – 40.2	Brattsrom, 1965; Schall, 1977; Bowker and Johnson, 1980; Paulissen, Cordes and Walker, 1989; Paulissen, 1999
A. guttata	38.9	Kennedy, 1968
A. hyperythra	39.0 – 39.9	Soulé, 1963; Brattstrom, 1965
A. inornata	38.6 – 40.2	Medica, 1967; Schall, 1977; Bowker and Johnson, 1980
A. laredoensis LAR-A	39.4 - 39.6	Paulissen, Cordes and Walker, 1989; Paulissen, 1999
A. laredoensis LAR-B	39.4 - 39.5	Paulissen, Cordes and Walker, 1989; Paulissen, 1999
A. lineatissima	31.1 - 36.5	Casas-Andreu and Gurrola-Hidalgo, 1993; Navarro-García, García and Méndez de la Cruz, 2008
A. neomexicana	≈ 39	Medica, 1967
A. uniparens	36.7	Bowker and Johnson, 1980
A. sexlineata	36.6 – 41.0	Bogert, 1949; Fitch, 1958; Brattstrom, 1965; Witz, 2001
A. tesselata	40.1 - 42.0	Bogert, 1949; Brattstrom, 1965; Schall, 1977
A. tigris	37.1 – 40.4	Brattstrom, 1965; Cunningham, 1966; Medica, 1967; Kay, 1970; Barbault, 1977; Schall, 1977; Lemos-Espinal, Smith and Ballinger, 1997
A. velox	38.7	Bowker, 1993

not affected by SVL (N = 64, r^2 = 0.02, P = 0.28). Body temperature was also not related to lizard mass (N = 64, r^2 = 0.009, P = 0.46).

Lizards were most often found in sun/shade mosaic microhabitats (30; 46.9%), followed by shaded microhabitats (12; 32.8%) and sunny microhabitats (13; 20.3%). Lizards in sun/shade mosaic microhabitats had the highest mean T_b (Table 2; $F_{2,61}$ = 8.18, P = 0.0007), mean T_a (Table 2; $F_{2,61}$ = 3.29, P = 0.044), but not significantly greater mean T_s (Table 2; $F_{2,61}$ = 2.71, P = 0.075).

Aspidoscelis sackii

Mean T_b was 38.29 ± 0.40 °C (N = 39). Mean T_a was 31.95 ± 0.68 °C (N = 39). Mean T_s was 31.75 ± 0.67 °C (N = 39). Body temperature was not significantly affected by T_a (N = 39, r^2 = 0.079, P = 0.083). However, T_b increased with T_s (N = 39, r^2 = 0.17, P = 0.009; T_b = 30.57 + 0.24T_s). Body temperature was not affected by lizard SVL (N = 39, r^2 < 0.0001, P = 0.97) or lizard mass (N = 39, r^2 = 0.003, P = 0.75).

Sunny microhabitats (19; 48.7%) were the most used, followed by shaded microhabitats (13; 33.3%), and sun/shade mosaic microhabitats (7; 17.9%). Microhabitat influenced T_b, with lizards in shaded microhabitats having lower mean T_bs (Table 2; $F_{2,36}$ = 3.44, P = 0.043). Microhabitat use had no effect on mean T_a (Table 2; $F_{2,36}$ = 2.44, P = 0.10), but did affect mean T_s (Table 2; $F_{2,36}$ = 9.88, P = 0.0004).

Discussion

The two species had similar mean T_bs (*A. parvisocia*: 37.2°C; *A. sackii*: 38.3°C). The T_bs of these two species are among the lowest mean T_bs published for *Aspidoscelis* (Table 1).

Body temperatures in *A. parvisocia* were affected by both T_a and T_s, whereas in *A. sackii* T_b was only affected by T_s. Environmental temperatures frequently affect the T_bs of *Aspidoscelis* (e.g. *A. deppii*, Vitt, Caldwell and Durtsche, 1993; *A. flagellicaudus*, Stevens, 1980; *A. inornatus*, Stevens, 1982; *A. laredoensis* LAR-A, Paulissen, 1999; *A. lineatissima*, Navarro-García, García and Méndez de la Cruz, 2008). Thus, the two species we studied fall into line with these observations. However, not all *Aspidoscelis* species show a significant relationship between T_b and environmental temperatures (e.g. *A. ceralbensis*, Soulé, 1963; *A. communis*, Casas-Andreu and Gurrola-Hidalgo, 1993; *A. exsanguis,* Bowker, 1993; *A. lineatissimus*, Casas-Andreu and Gurrola-Hidalgo, 1993), suggesting further study exploring why such variation exists among

Table 1. Mean body temperature (Tb), air temperature (Ta), and substrate temperature (Ts) of two species of *Aspidoscelis* from Mexico found in sunny, sun/shade mosaic, and shaded microhabitats. Means are given ± 1 SE.

	T_b (°C)	T_a (°C)	T_s (°C)
A. parviocia			
Sunny (N = 13)	35.8 ± 0.49	31.05 ± 0.85	32.7 ± 0.76
Sun/Shade Mosaic (N = 30)	38.7 ± 0.45	33.8 ± 0.64	35.3 ± 0.74
Shaded (N = 21)	35.8 ± 0.83	32.5 ± 0.73	33.6 ± 0.80
A. sackii			
Sunny (N = 19)	38.9 ± 0.30	32.8 ± 0.87	33.3 ± 0.73
Sun/Shade Mosaic (N = 7)	39.3 ± 0.51	33.3 ± 1.49	33.9± 1.33
Shaded (N = 13)	36.9 ± 0.99	29.9 ± 1.27	28.3 ± 1.06

species may provide information on factors influencing thermoregulatory strategies or abilities in *Aspidoscelis*.

Both species used a variety of microhabitats relative to solar insolation, and lizards using these different microhabitats had significantly different T_bs. This suggests the possibility that these species of *Aspidoscelis* may use these microhabitats to influence their T_b. Our results are similar to previous studies that have found *Aspidoscelis* can use microhabitats to maintain their T_b. Individuals that were basking had lower T_bs than those that were active or in shade in five species of *Aspidoscelis* (Schall, 1977), and other species of *Aspidoscelis* shuttle between sun and shade to regulate T_b (Bowker and Johnson, 1980; Bowker et al., 1986; Casas-Andreu and Gurrola-Hidalgo, 1993).

In both species, body size did not affect T_b. This is similar to other studies that found that adult and juvenile *Aspidoscelis* do not differ in mean T_b (e.g., *A. dixoni*, Walker et al., 1991; A. *inornatus*, Stevens, 1982; *A. laredoensis* LAR-A and LAR-B, Paulissen et al., 1989; *A. sexlineatus*, Carpenter, 1960; Paulissen, 1988). However, adult and juvenile *A. gularis* differed in mean T_b with adults having a higher mean T_b than juveniles (Paulissen, Cordes and Walker, 1989). It thus appears that lizard size is frequently not important in the T_b experienced by *Aspidoscelis*, although this is not universal. It would be interesting to see if thermoregulatory strategies are similar for large and small individual *Aspidoscelis*.

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