2011

Body temperatures of Hyla arenicolor from Sierra de Tepozotlan, Estado de Mexico, Mexico

F. Correa-Sanchez

Geoffrey R. Smith

G. A. Woolrich-Pina

J. A. Lemos-Espinal

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Body temperature affects numerous aspects of locomotory and physiological performance of *Hyla* treefrogs (Navas 1996b), In addition, climatic conditions, including temperature, are likely to drive the differential distributions of some *Hyla* species (Otto et al. 2007). It is thus important to gain a better understanding of the temperature relationships of *Hyla* frogs. However, there is relatively little known about temperature relationships in the genus *Hyla*. Here we report on the temperature relationships of *Hyla arenicolor* from Sierra de Tepozotlan, Estado de México, Mexico in an effort to expand the database of temperature relationships in treefrogs.

Materials and Methods

We conducted this study in Sierra de Tepozotlán (19° 42´ 23.4´´ N, 99° 15' 17.6" W and 2300 m elevation), in Estado de México, Mexico. Mean annual temperature and precipitation are 16°C and 650 mm, respectively. Plant species include *Quercus crassipes*, *Q. microphylla*, *Q. rugosa*, *Bouteloua curtipendula*, *B. gracilis*, *B. hirtusa*, *Lycurus phleoides*, *Piptochaetium fimbriatum*, *Aegopogon cenchroides*, *Festuca* sp., *Pictochaetium fimbriatum*, *Bromus* sp., *Aristida* sp., *Oennetum clandestinum*, *Eragrostis* sp. and *Hilaria cenchroides*, principally (Rzedowski 2006).

We captured frogs by hand. Once captured, we recorded snout vent length (SVL, to nearest 1 mm), body mass (to nearest 0.2 g, using a spring balance), and 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 frog's position with regard to solar insolation as being completely exposed to sun, in shade, or in a sun/shade mosaic. Frogs that needed a major effort to capture (> 1 min.) were excluded from temperature records. We used only one observation for each frog.

Results and Discussion

Mean T_b was 25.11 ± 0.34 °C (N = 48). Mean T_a was 19.04 ± 0.32 °C (N = 48). Mean T_s was 21.69 ± 0.35 °C (N = 48). Mean T_b for our population of *H. arenicolor* is higher than that observed in a population of *H. arenicolor* from Colorado (20.7°C; Snyder and Hammerson 1993). Our observed mean T_b is within the range of T_bs observed in *Hyla microcephala* and *H. ebraccata* from low elevations in Panama (Navas, 1996b), but is higher than in the high elevation *H. lavialis* (Valdiviseo and Tamsitt 1974; Navas 1996a,b). *Hyla regilla* from southern California had T_bs that ranged from 14.3 – 22.2 °C (Brattstrom and Warren 1955). *Hyla cinerea* from Louisiana had nocturnal T_bs ranging from 19.1 – 27.7°C (Wygoda and Williams 1991).

Body temperature increased with T_a ($N = 48, r^2 = 0.18, P = 0.0022; T_b = 16.26 + 0.46T_a$). Body temperature also increased with T_s ($N = 48, r^2 = 0.28, P = 0.0001; T_b = 14.02 + 0.51T_s$). The T_bs of *H. arenicolor* from Colorado tended to be higher than T_a but lower than T_s (Snyder and Hammerson 1993). The dependence of T_b on T_a has been found in other *Hyla* species (Valdivieso and Tamsitt 1974; Wygoda and Williams 1991; Navas 1996a).

Body temperature increased with frog SVL, but only a small amount of variation in T_b was explained by SVL ($N = 48, r^2 = 0.08, P = 0.046; T_b = 22.01 + 0.13SVL$). Body temperature was not related to frog mass ($N = 46, r^2 = 0.04, P = 0.16$). Body temperature was not affected by

SVL in *H. labialis* (Valdivieso and Tamsitt 1974).

Most frogs were observed in sunny microhabitats (30; 62.5%), followed by mosaic microhabitats (12; 25%). Few frogs were observed in shade (6; 12.5%). Microhabitat did not affect T_b (Table 1; $F_{2,45} = 1.86$, $P = 0.17$), T_a (Table 1; $F_{2,45} = 0.06$, $P = 0.94$), or T_s (Table 1; $F_{2,45} = 0.99$, $P = 0.38$). Snyder and Hammerson (1993) found all of the *H. arenicolor* they observed in June in Colorado in full sun.

In conclusion, the temperature relationships we observed in *H. arenicolor* from Tepozotlan, Estado de México, Mexico, are fairly similar to previous studies on the thermal ecology of *H. arenicolor* and other species of *Hyla*.

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

	T_b (°C)	T_a (°C)	T_s (°C)
Sunny (N=30)	25.41 ± 0.35 °C	18.96 ± 0.41 °C	22.06 ± 0.38 °C
Sun/Shade Mosaic (N=12)	25.22 ± 0.83 °C	19.16 ± 0.63 °C	21.24 ± 0.83 °C
Shaded (N=6)	23.42 ± 1.19 °C	19.25 ± 0.93 °C	20.07 ± 1.27 °C

Acknowledgments.

This study was supported by the projects: PAPIIT IN 221707, PAPCA 2008-2009; 2009-2010.

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Felipe Correa-Sánchez[1], Geoffrey R. Smith[2,4], Guillermo A. Woolrich-Piña[3], and Julio A. Lemos-Espinal[3]

[1]Laboratorio de Herpetología, Vivario, FES Iztacala UNAM, Av. De los Barrios # 1 Col. Los Reyes Iztacala, Tlalnepantla, Estado de México, México. C. P. 54090.

[2] Department of Biology, Denison University, Granville, Ohio 43023 USA.

[3] Laboratorio de Ecología, Unidad de Biología, Tecnología y Prototipos, FES Iztacala UNAM, Av. De los Barrios # 1 Col. Los Reyes Iztacala, Tlalnepantla, Estado de México, México. C. P. 54090.

[4] Author for Correspondence: smithg@denison.edu

Received: 6 May 2011
Accepted: 26 July 2011