Thermoregulatory patterns of non-native *Norops sagrei* in a novel thermal environment

Austin Hulbert

Tim Mitchell, Josh Hall, Daniel Warner

Warner Lab, Department of Biological Sciences, Auburn University

Background

- The ranges of non-native reptiles are often limited by the cooler temperatures they experience as latitude increases[1].
- The brown anole (*Norops sagrei*) is a small lizard endemic to Cuba and the Bahamas, that has extended its non-native range to the southeastern United States and Hawaii.[2]
- A reproducing colony of brown anoles has been occupying a set of unused greenhouses in Auburn, Alabama for several years. The temperature inside these greenhouses can exceed 48°C during the hot summer months.

Research Questions

- How do thermal patterns differ between the inside and outside of the greenhouses?
- What spatiotemporal factors correspond with anole thermoregulation within this novel environment?

Methods Summary

Temperature Data

- 10 iButton temperature data loggers were placed outside around the surrounding area, and 16 iButtons were placed inside the greenhouses.
- iButtons were placed on a multiple types of substrates with varying levels of exposure.

Visual Surveys

- Visual surveys were conducted during June and July 2016.
- Upon arrival at the greenhouses, time, inside air temperature, and outside air temperature were recorded.
- Visual transects for lizards were conducted outside and inside the greenhouses in a consistent manner.
- When a lizard was spotted, data was taken on its activity, location, substrate, sex, and age.

	Inside	Outside	P-value
Mean	33.3 (±2.6)	28.8 (±2.1)	<0.0001
Minimum	23.0 (±2.0)	20.8 (±1.4)	0.0070
Maximum	52.0 (±9.6)	42.7 (±8.6)	0.0189
Range	29.1 (±11.1)	21.8 (±9.7)	0.1021

Table 1. Values (± Standard Deviation) for mean daily mean, mean daily minimum, mean daily maximum, and mean daily range of temperatures (˚C) outside and inside the greenhouses along with the associated p-value.

Results

- Mean, maximum, and minimum temperatures of the outside and inside of the greenhouses differed significantly, but the range of temperatures between the two did not differ significantly (Table 1).
- On average, more anoles were sighted inside than outside for all time range (Figure 2).
- Substrate use of anoles varied across time (Figure 3).

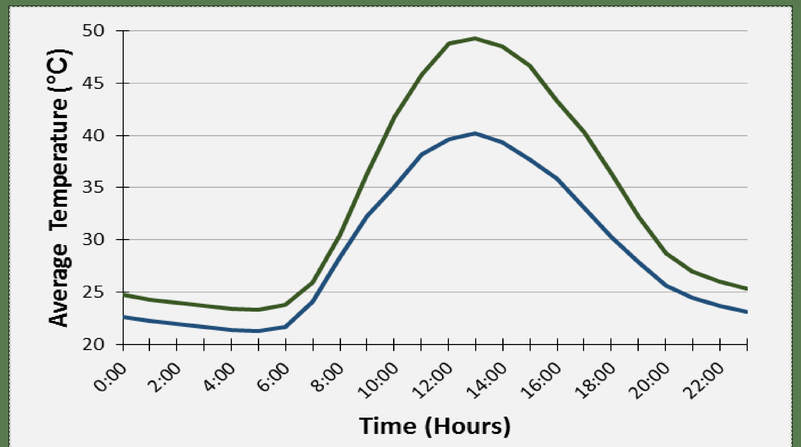

Figure 1. Average temperatures at each hour for outside (green line) and inside (blue line) the greenhouses.

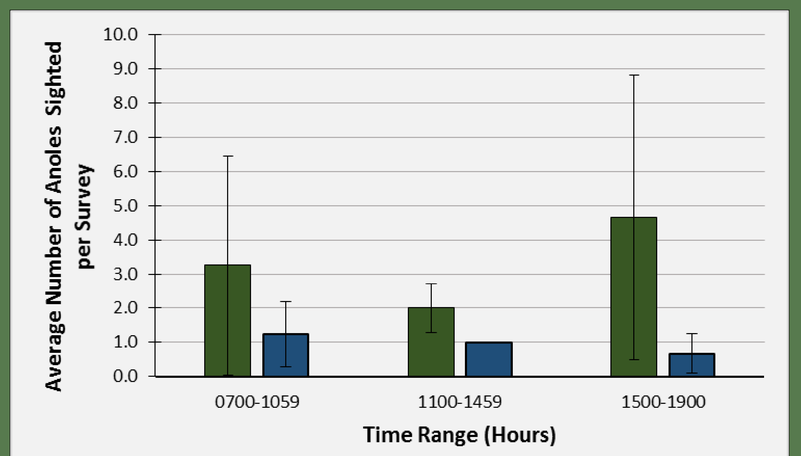

Figure 2. Average number of anoles sighted outside (blue bars) and inside (green bars) the greenhouses during visual surveys at morning, mid-day, and evening time ranges.

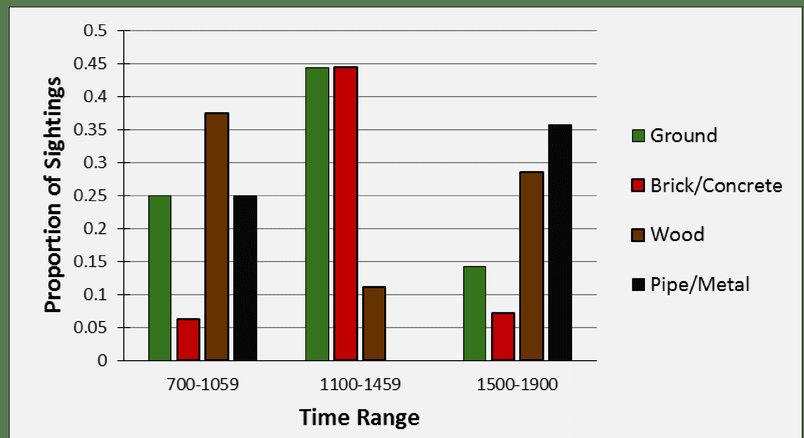

Figure 3. Proportion of lizard sightings on multiple substrates at morning, mid-day, and evening time ranges..

Conclusions

- We saw no evidence of anoles traveling outside to escape peak temperatures, but with temperatures capable of reaching almost 50 ˚C inside the greenhouses, they must find other ways to thermorgulate or risk injury/death.
- Concrete and brick at the greenhouses are located close to the ground, which may be an area of cooler temperatures. Perhaps the anoles are altering their behavior to deal with the heat by perching low during mid-day hours.
- During visual surveys, we did not move any cover objects or search subterranean crevices. These might be cooler areas that anoles are utilizing to survive the hot temperatures.
- During the winter months, similar studies will be conducted to observe how this population of non-native, neotropical lizards survives with outside temperatures dropping lower than they experience in their typical range.

Acknowledgements

Funding was provided from the National Science Foundation. We thank Plant World Nursery for allowing us to study this population of anoles at their greenhouses. We also thank Danielle Douglas and Cassie Guiffre for help conducting visual surveys.

Works Cited

1. Fujisaki I., F.J. Mozzotti, J. Watling, K.L. Krysko, and Y. Escribano. 2015. GEOGRAPHIC RISK ASSESSMENT REVEALS SPATIAL VARIATION IN INVASION POTENTIAL OF EXOTIC REPTILES IN AN INVASIVE SPECIES HOTSPOT. Herpetological Conservation and Biology 10(2):621–632.
2. Powell, R., R. Conant, J.T. Collins, I.H. Conant, T.R. Johnson, E.D. Hooper, and T.W. Taggart. *Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America*. 4th ed. New York: Houghton Mifflin Harcourt, 2016. Print.