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Can lizard embryos survive climate warming? Thermal constraints on the physiology of developing Eastern fence lizards

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Can lizard embryos survive climate warming? Thermal constraints on the physiology of developing Eastern fence lizards (*Sceloporus undulatus*)

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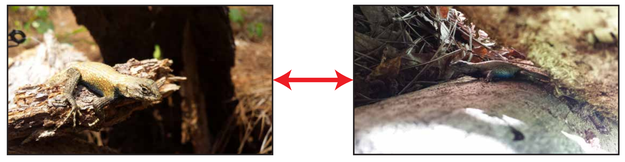
Question

How does exposure to sublethal high temperatures due to warming affect embryos and hatchlings?

Introduction

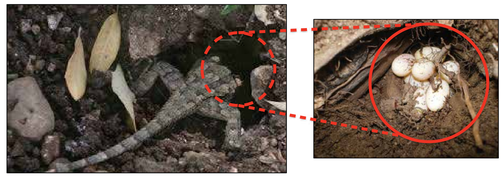
Eastern fence lizard (*Sceloporus undulatus*)

- very well studied system in thermal ecology
- widespread across North America
- ectotherm (obtains heat from environment)



Mobile ectotherms can alter behavior to maintain temperatures within preferred ranges. For instance, lizards shuttle between the sun and shade.

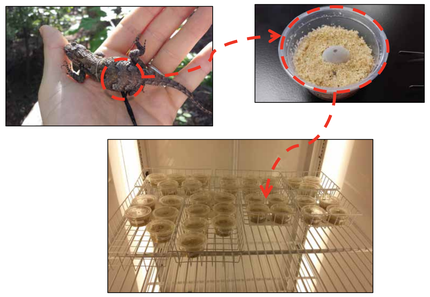
But what about animals in sessile life stages that lack the capacity for behavioral thermoregulation?



Fence lizards lay eggs in shallow underground nests where **immobile embryos** must depend on ambient nest conditions during development.

Embryos are exposed to recurrent thermal stress as nest temperatures fluctuate daily. Under climate warming, thermal stress will increase due to rising nest temperatures. **This project examines the effects of warming nest temperatures.**

Methods



S. undulatus females were brought from our field site in Sumter National Forest in SC to our lab at Clemson University, where they were kept until laying eggs. We collected the eggs and reared them in environmental chambers programmed to specific nest conditions.

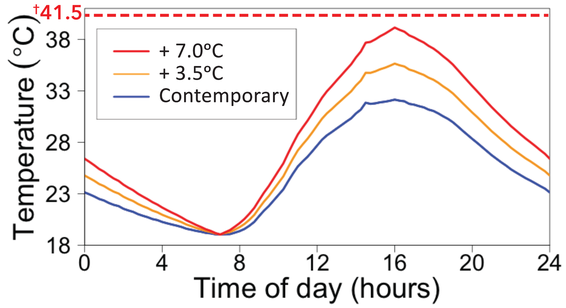


Figure 1. The "Contemporary" treatment simulated a typical daily thermal cycle for a fence lizard nest in SC. Two warming treatments simulated climate warming scenarios, raising maximum daily temperatures by 3.5°C and 7.0°C. We reared eggs under randomly assigned treatments, keeping track of changes in physiology and survival through development.

Results

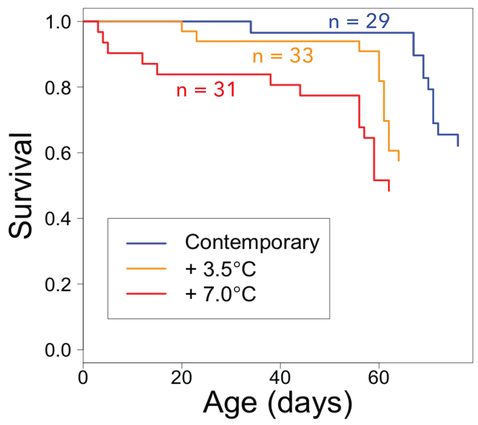


Figure 2. Decreased survivorship of embryos in warmer nests

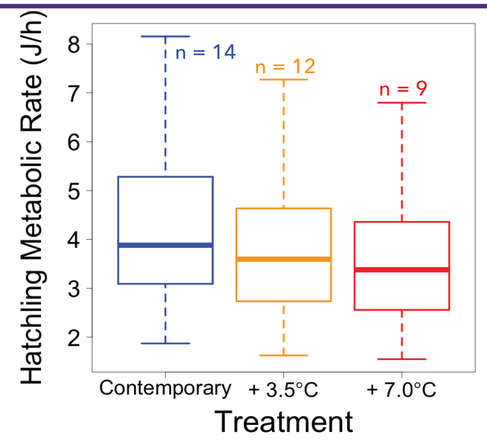


Figure 3. Decreased metabolic rates in hatchlings from warmer nests, measured 7 days post-hatching

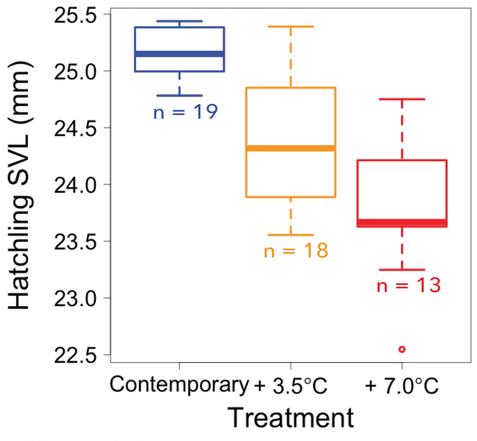


Figure 4. Decreased snout-vent length (SVL) of hatchlings from warmer nests, measured immediately post-hatching

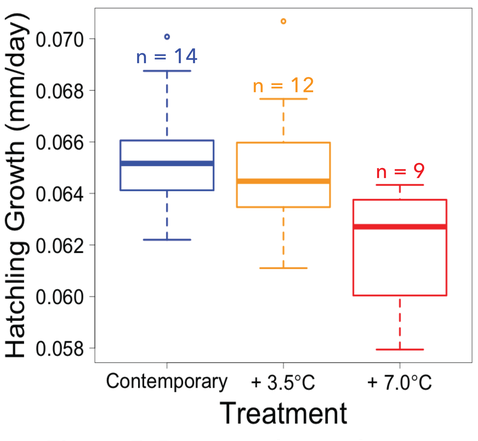


Figure 5. Decreased growth rates (SVL) of hatchlings from warmer nests for first 3 weeks post-hatching

Conclusion

These results have serious implications for *S. undulatus* under climate change. Lower metabolic rates of hatchlings from warmer nests indicate a potential acclimation response to sublethal warming. However, decreased survival and reduced growth suggest that such a response is not enough to overcome the costs of developing under warmer nest conditions.

Therefore, **thermal constraints on the physiology of developing Eastern fence lizards may limit the persistance of the species under climate warming.**

Future Directions

- What are the long-term effects of sublethal warming in the nest (through all life stages)?
- Can female lizards adjust nesting behavior in response to changes in the thermal environment?
- Are thermal traits of lizards heritable? (i.e., can populations adapt to climate change?)

Literature Cited

†Angilletta, MJ, MH Zelic, GJ Adrian, AM Hurliman & CD Smith. 2013. Heat tolerance during embryonic development has not diverged among populations of a widespread species (*Sceloporus undulatus*). *Conservation Physiology* 1:1-9.

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