The effects of incubation temperature on larval morphology of the locally endangered Streamside Salamander (*Ambystoma barbouri*)

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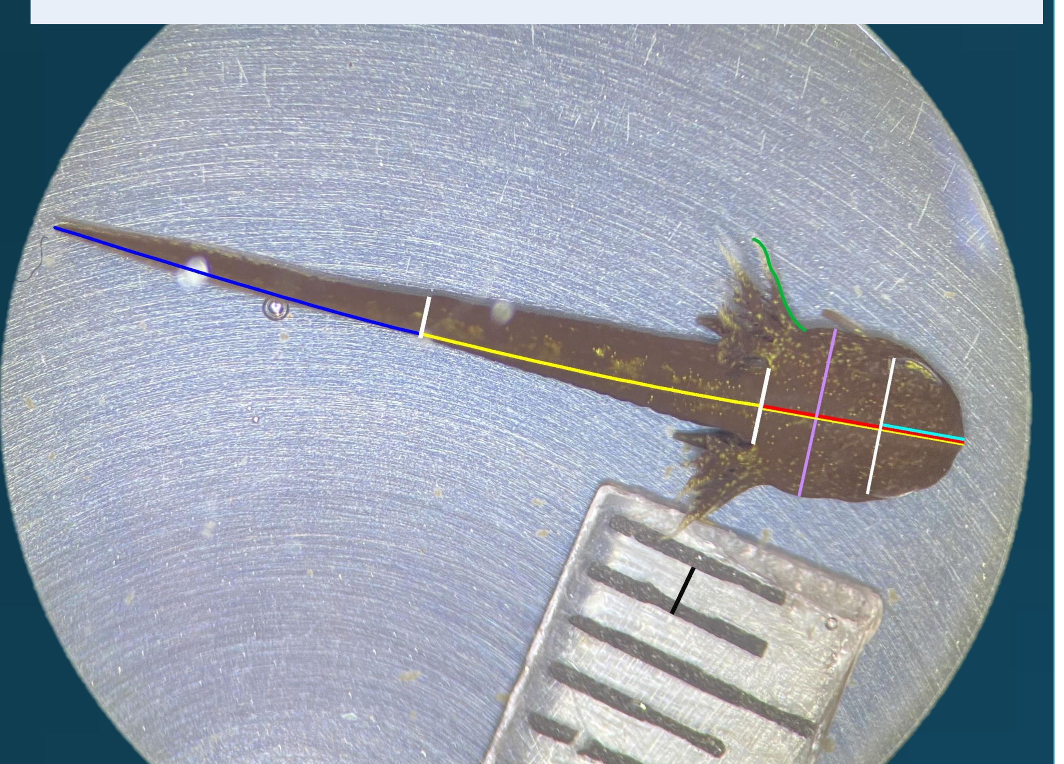
Introduction

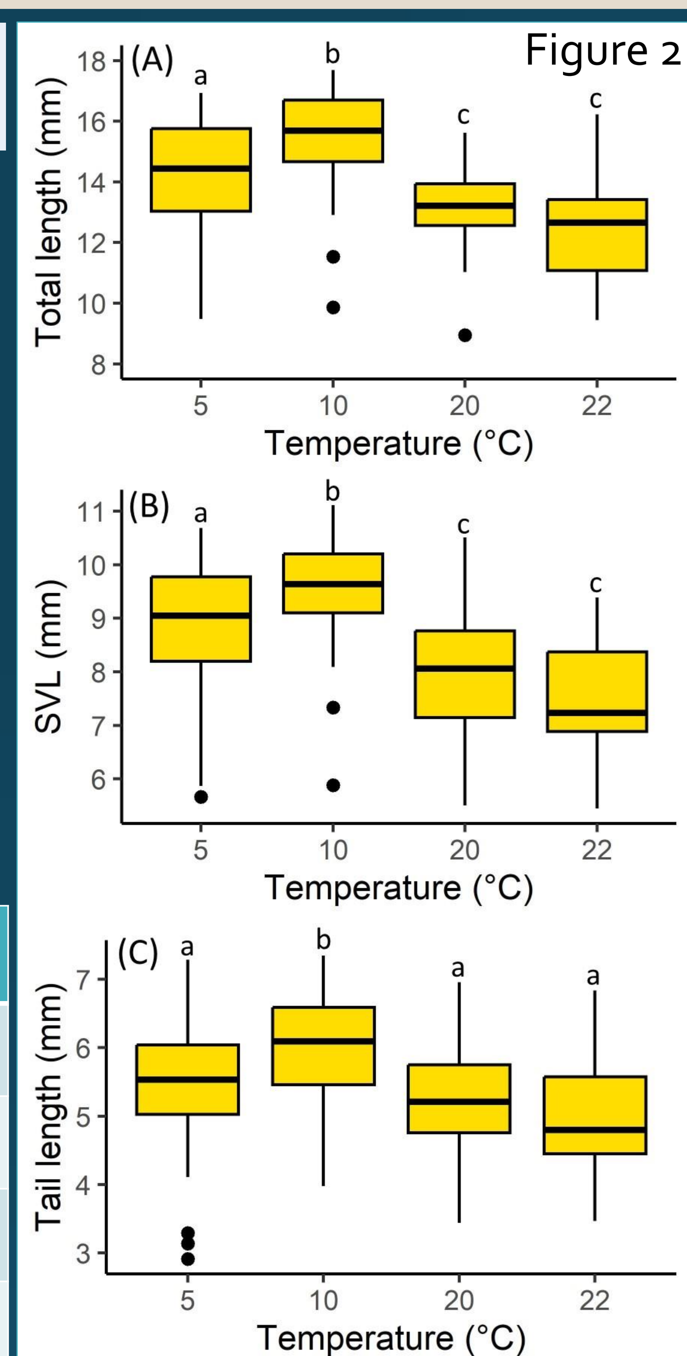
The streamside salamander (Ambystoma barbouri) is a state-endangered species in Tennessee that is threatened by urbanization resulting in elevated water temperatures at nesting sites (in areas of Fig. 3).

To see how incubation temperatures influence morphology, we focused on body size, head morphology, and gill length since these can dictate survival (i.e. swimming speed, prey capture, metabolism).*

Measurements



Legend	Figure 1
Scale	Gill Length
Tail Length	Head Width
Head Length	Snout Vent Length
Snout Length	Total Length

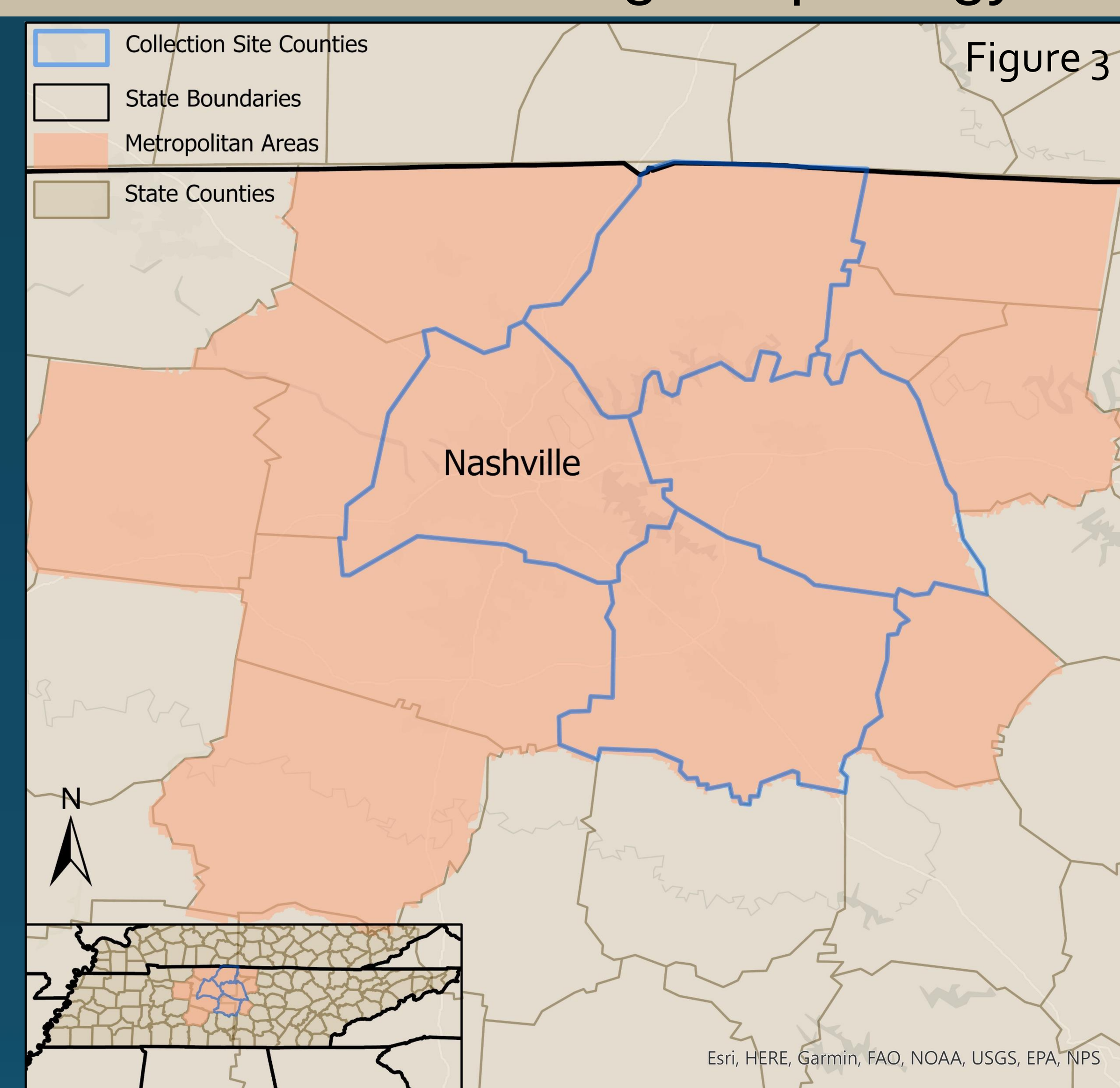


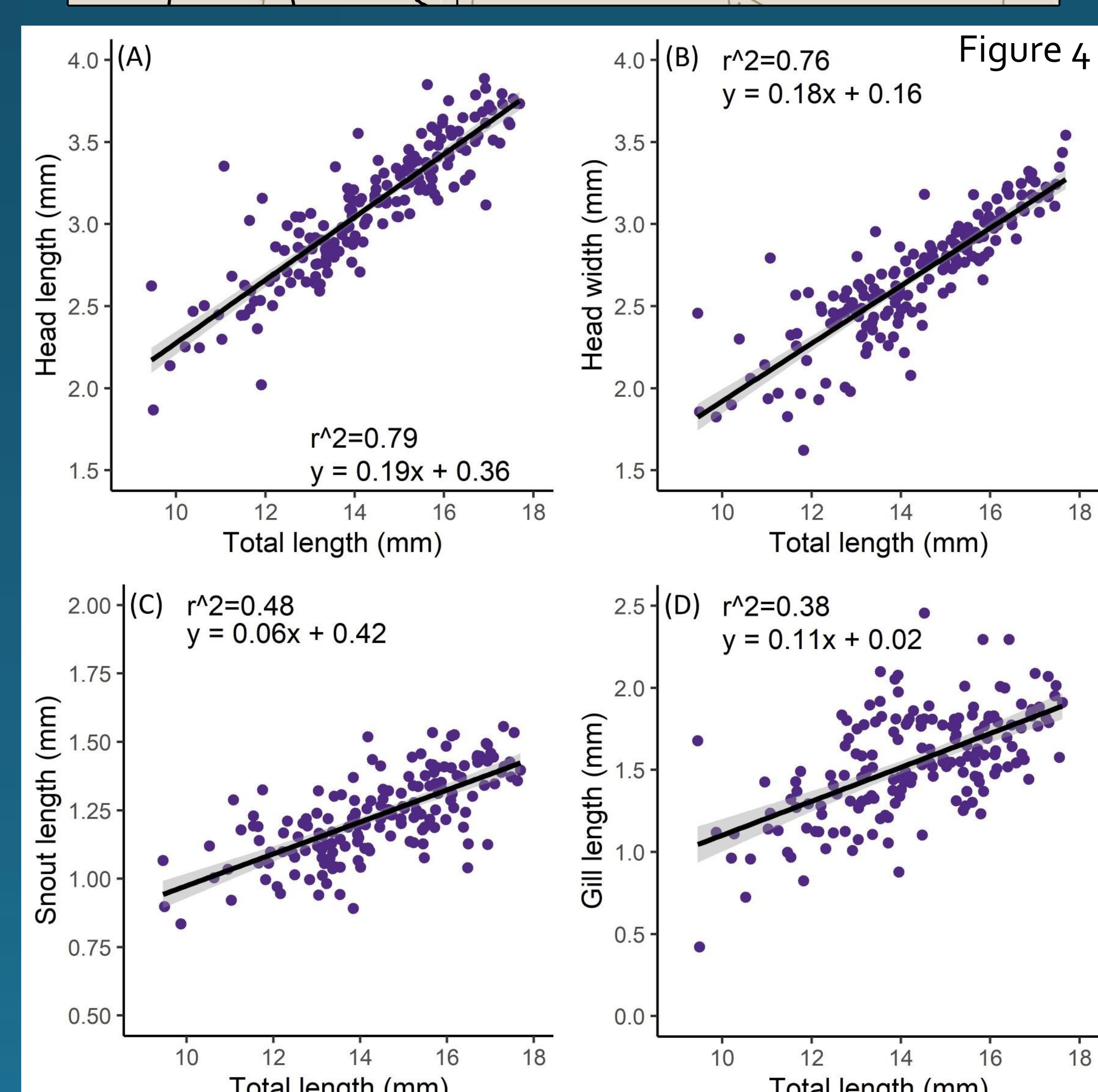
Methods

We studied the morphology of these Tennessee salamanders after incubating randomized sets of eggs from three genetic clades in differing temperature ranges from 5 ℃ to 22 ℃ by photographing hatchlings and taking measurements using ImageJ.

We used linear mixed effects models using the lmerTest package to analyze metrics of body size according to treatment. For head and gill morphology, total body length was a covariate. The random effects for all models was clutch ID nested in population (Fig. 2).

How do incubation temperatures influence hatchling morphology?

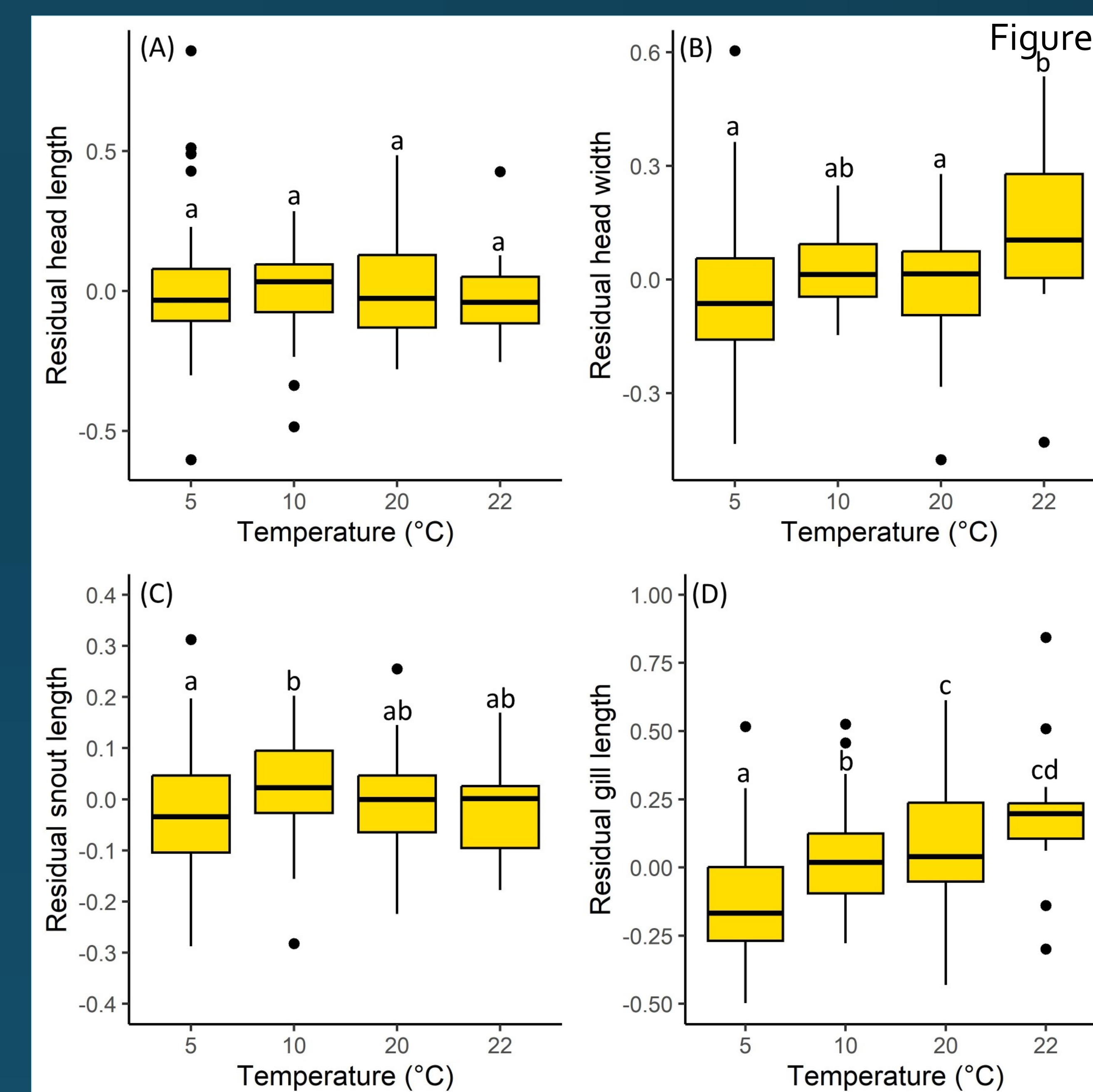




Results

Total body length, SVL, snout length, and tail length were largest at 10℃ and smaller at cooler and warmer temperatures.

Temperature had no effect on head length, but head width and gill length trend upward with temperature (Fig. 5). All measurements of head and gills scale concurrently with body size (Fig 4).



Conclusion

Embryos typically develop at about 10℃ and have adapted physiological development to maximize efficiency at that temperature. Longer gills at warmer temperatures may be a form of adaptive plasticity, helping meet increased oxygen needs at warm temperatures. Warming nest temperatures due to climate change or urbanization may be detrimental.

Acknowledgments:

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*Smith, C., Telemeco, R. S., Angilletta Jr, M. J., & VandenBrooks, J. M. (2015). Oxygen supply limits the heat tolerance of lizard embryos. *Biology letters*, *11*(4), 20150113

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