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Development/performance tradeoffs in wood frog tadpoles

Research Summary

Wood frogs are amphibians that breed in ephemeral ponds, a common habitat type in Yale-Myers Forest. Wood frogs begin breeding as soon as ice melts off the ponds in the spring, and their aquatic larvae (tadpoles) must metamorphose and leave the ponds before the water dries up in the summer.

Recent research by A. Z. Andis Arietta in the Skelly lab has shown that in the face of climate change, wood frogs are seeing warmer temperatures and faster pond drying in the summer. At the same time, the beginning of their breeding season has been delayed by several days due to later spring ice melt. This means that wood frog tadpoles are experiencing selective pressure to develop more rapidly.

In collaboration with Andis, I am investigating whether tadpoles experience an effect on their swimming performance due to this faster development. This spring and summer, we collected wood frog egg masses from YMF ponds and reared tadpoles in the lab under two different temperature regimes, representing the extremes of temperatures that they were likely to experience in the wild. We assessed tadpoles' metabolism by placing them in flow-through chambers and measuring how much oxygen they consumed while swimming. My primary focus for the summer was another measurement of swimming performance, the tadpoles' burst swimming speed. To do this, I placed each tadpole in a wide, shallow tray and tapped its tail with a probe to startle it into swimming. By filming the "bursts" from overhead, I could calculate how fast each tadpole swam.

Holding a grey tree frog while conducting field work at Yale-Myers Forest.

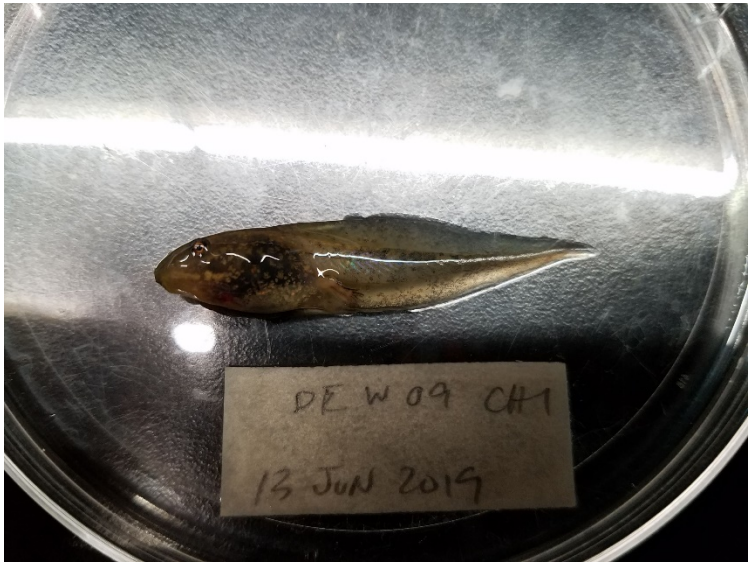
Conducting a trial by gently tapping a tadpole's tail with a probe to induce a burst of swimming.

Research Summary cont.

I have finished processing these data and am ready to move forward with analyses. First, I will confirm that burst swimming speed is a relatively fixed characteristic of an individual tadpole. If this is the case, I should see more variation in speed between tadpoles than between different burst trials of the same tadpole. My primary hypothesis is that tadpoles' burst swimming speeds should differ depending on their developmental regime. If a tradeoff does exist between developmental rate and swimming performance, then faster-developing tadpoles (those raised under warmer conditions) should have slower burst swimming speeds, and vice versa.

I am also using these data to investigate a few related questions. By photographing each tadpole after its tests, we were able to collect comprehensive morphometric data, so I will be able to assess whether tadpoles' body shape differs according to its developmental temperature. Finally, I will assess differences between tadpoles originating from different ponds. Previous work in the lab has shown countergradient variation in tadpole developmental rates: ponds vary in their temperatures, and tadpoles from colder ponds have evolved faster intrinsic developmental rates to compensate for their environmental conditions. If intrinsic developmental rates trade off with swimming performance, then I would expect to observe differences in burst swimming speed among tadpoles originating from different ponds. Finally, it will be interesting to compare the burst speed results to metabolic measurements of the same tadpoles to see if similar patterns emerge.

Wood frog tadpoles, collected from a variety of ponds in YMF and reared in the lab, awaiting their burst speed trials.



A tadpole after burst testing, ready to be photographed and measured.