The Tank of Fear
Phenotypic Plasticity in *Bufo marinus* and *Lithobates taylori* Tadpoles

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ABSTRACT

Many species of tadpoles demonstrate phenotypic plasticity in response to abiotic and biotic cues in their environment. For example, controls such as water quality, pond size, and intraspecific and interspecific competition have been found to have a lasting effect on the morphology and behavior of some species of tadpole (Gonzalez, 2001). This experiment quantified the effects of predator presence on growth and development in two species of tadpole, *Bufo marinus* and *Lithobates taylori*, in San Luis, Costa Rica. Tadpoles were captured from a pond and divided into groups that would or would not receive a predator treatment. Average instantaneous growth rate and developmental stage was determined for each tadpole tank over the duration of eighteen days. Our experiment supports the hypothesis that the presence of a predator creates a cue that may induce an effect on growth rate and development in both the *B. marinus* and *L. taylori* tadpole species.

OBJECTIVE

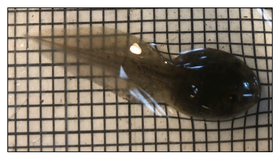
Compare the difference in growth rates and development of two species of tadpoles in response to the presence or absence of a predator.

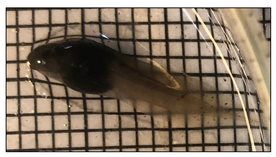
METHODS

FIELD COLLECTION: Tadpoles and dragonfly larvae were collected from the same natural pond at UGA Costa Rica's medicinal garden in San Luis, Costa Rica.

EXPERIMENTAL SETUP: 60 tadpoles, 30 of B. marinus and 30 of L. taylori, were separated into twelve tanks by groups of five. The samples were then taken to an area outside the lab to best represent natural daily temperature fluctuations. Half of these tanks contained dragonfly larvae, natural predators of these tadpoles, behind a mesh divider which allowed for a visual cue of the predators as well as a chemical cue.

DATA COLLECTION: Growth was measured by taking a photo of each individual tadpole on grid paper for scale and then measured to the closest mm using ImageJ software. Development, measured as Gosner Stage, was determined using a microscope for each individual.





Growth rate was calculated using the following equation:
IGR = (ln(final growth) – ln(initial growth)) / number of days

RESULTS

MORTALITY: Average survivorship was higher among the *B. marinus* species that experienced no predation. However, *B. marinus* species had the lowest average survivorship in predation treatments. *B. marinus* species showed a large decline in survivorship from the non-predated tanks (93%) to the predated tanks (60%) (Figure 1). There was no difference in average survivorship in the *L. taylori* species between the tanks that were predated or non-predated (Figure 1).

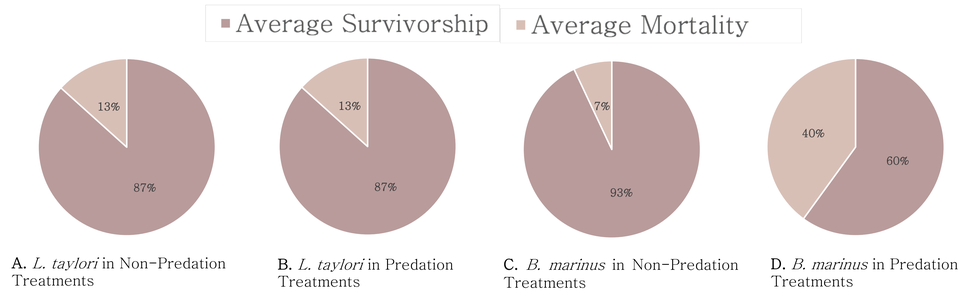


Figure 1. Survivorship Among *L. taylori* and *B. marinus* in Non-predated and Predated Treatments

GROWTH RATE: *B. marinus* tadpoles experienced a higher growth rate than the *L. taylori* tadpoles. A slightly higher average IGR was observed in non-predated tanks than in predated tanks among both species of tadpole although these differences in growth were not significant (two-way ANOVA p = 0.19). The *B. marinus* tadpoles experienced an average IGR of .0101 (± 0.01) in tanks that were not predated and a rate of .0085 (± 0.01). The *L. taylori* tadpoles experienced an average IGR of 0.0031 (± 0.004) in tanks that were not predated and a rate of 0.0027 (± 0.002) in tanks with a predator present (Figure 2).

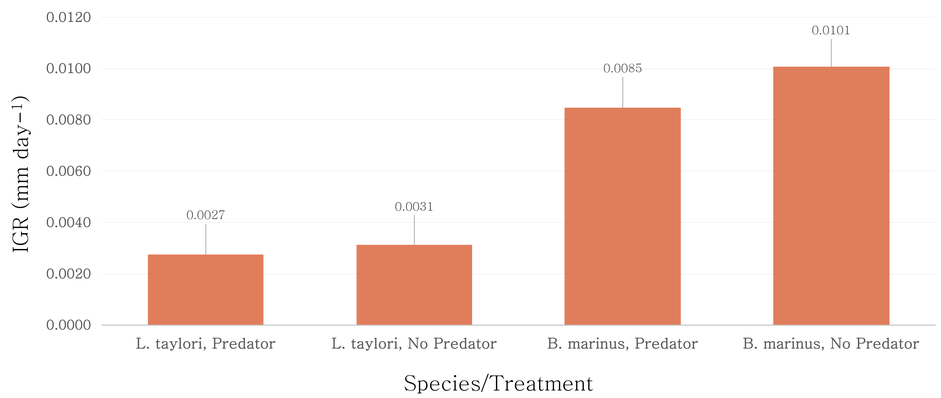


Figure 2. Average Instantaneous Growth Rate (IGR mm day^{-1}) between Predation and Non-Predation Treatments in *L. taylori* and *B. marinus* tadpole species

DEVELOPMENT: All tadpoles started with a Gosner stage of 25. Overall, the tadpoles in the predation treatments experienced a slightly higher Gosner stage than those in the control or non-predation treatments although these were not significant (~25.6). In each treatment there were a couple tadpoles that were starting to develop limb buds.

CONCLUSIONS

- Predation treatments yielded tadpoles with a lower instantaneous growth rate and later development according to their Gosner stage.
- Predation may induce slower growth but faster development, whereas lack of predation in an environment may induce faster growth but slower development. This observed trend indicates that the presence or absence of a predator visual or chemical cue has an effect on tadpole growth rate and development.
- *B. marinus* demonstrated a more plastic response in IGR to predation than *L. taylori*. This finding supports an overarching pattern of decreased growth rate in response to predation, and also to competition among other species of tadpole, and an ability for the tadpoles to be able to fine tune their phenotype to a variety of environmental pressures (Relyea, 2004).
- One major limitation to our study may have been the availability of algal food resources. Even though algae was added, it may not have been enough to support growth and development therefore minimizing the effects we measured in growth and development.

FUTURE DIRECTIONS

Future studies should examine the interaction of predators and food availability and quality on tadpole growth and development. Lastly, conducting the study through development would give further insight into the phenotypic response of predators on tadpole growth and development.

CONTACT

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