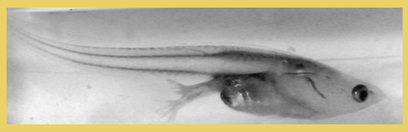
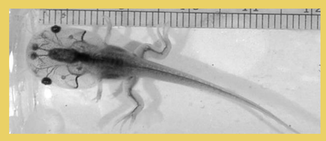
Growth and development of African Clawed Frog (*Xenopus laevis*) larvae reared under different intensities of LED light at night



J. Liu, D. Haasbeek, K. Johnson, S. Wise, & B. Buchanan

Department of Biology, Utica College, Utica, NY, 13502, USA



Amphibian populations are declining globally due to several anthropogenic stressors including habitat loss, climate change, introduced species, pollution, and disease (Grant *et al*., 2016). Most amphibians are nocturnal so the global increase in light pollution (Artificial Light At Night, ALAN) and its disruption of natural, dark nights is another potential stressor that may affect amphibians that are reliant upon distinct light-and-dark-dependent circadian cues and dark nocturnal illuminations (Buchanan, 2006). Cell division appears to be under photoperiodic (Morgan and Mizell, 1971) and thus normal patterns of cell division, growth, and development regulated by photoperiod are at risk of disruption by ALAN. Although Ruchin (2018) found no effect of lighting on the earliest stages of embryonic growth and development in amphibians, research in our lab has demonstrated that fluorescent ALAN accelerates growth but delays development in *X. laevis* larvae. In this study, we examined the effects of ecologically relevant amounts of LED ALAN on the growth and development of tadpoles.

HYPOTHESIS: Ecologically relevant amounts of LED ALAN affect growth and development of larvae of African Clawed Frogs.

Methods:

- **4 night light treatments, daylight (100 lx) for all treatments (Fig. 1)**
- **4 replicate chambers per light treatment, 4 sibling groups, and 20 larvae per chamber**
- **Reared from eggs to 37 d on 2L:12D photoperiod**
- **Temperature was the same across treatments**
- **Fed equal amounts of food (*Spirulina*) daily**
- **Body size (SVL, mm) measured with ImageJ (NIH) software**
- **Developmental stage identified using Niewkook and Faber (1994)**

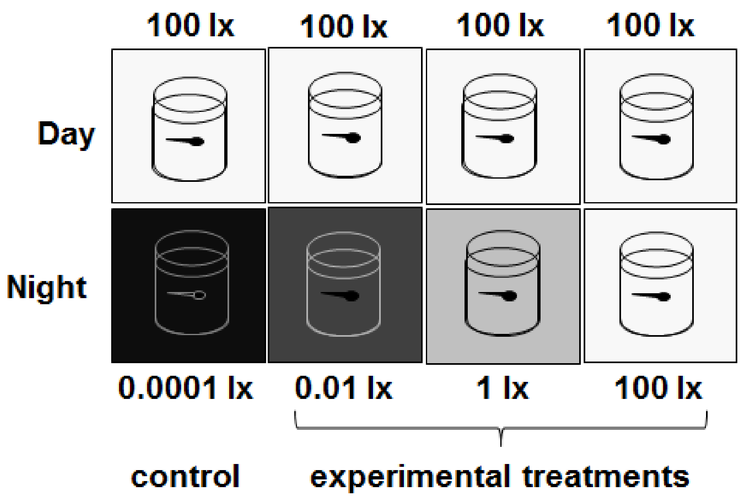


Figure 1: Experimental design and test chamber setup.

RESULTS

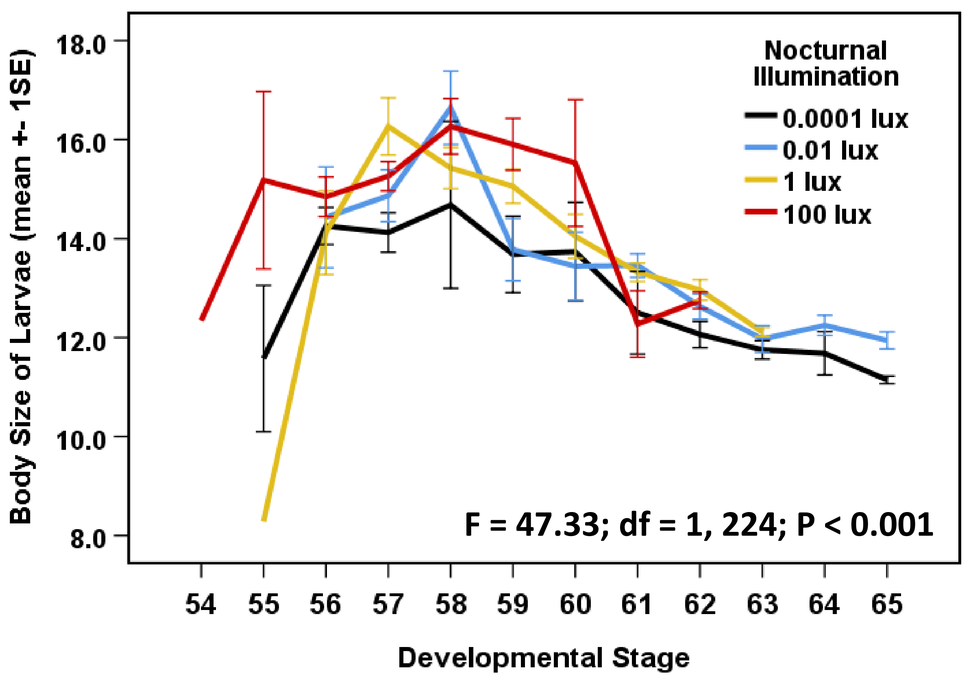


Figure 2: Body size (SVL in mm) of larvae is significantly dependent on developmental stage in each nocturnal light treatment.

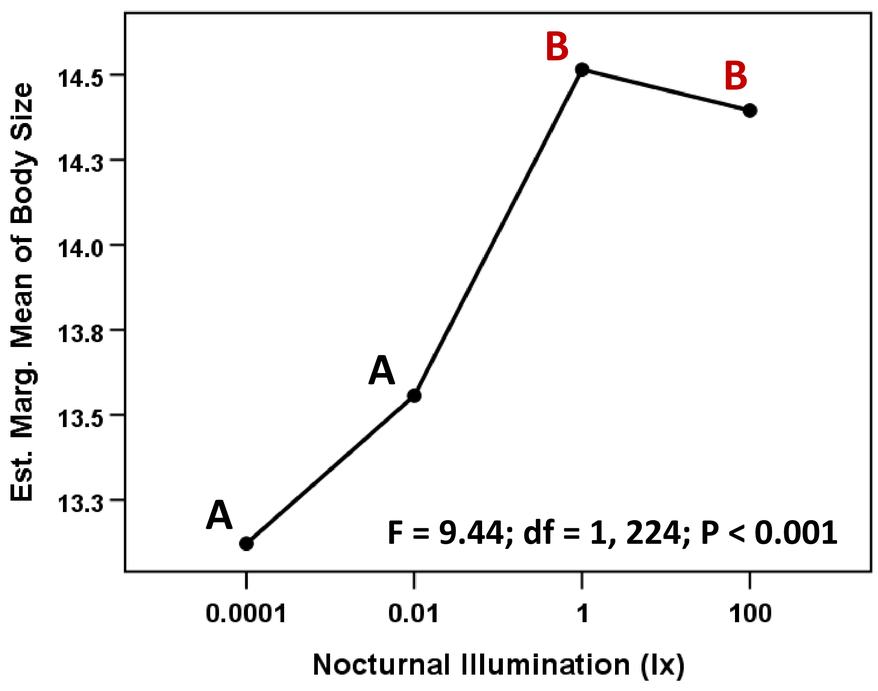


Figure 3: Effect of lighting treatment on larval body size (covariance with stage, chamber, and sibling group removed). Larvae grew significantly larger at 1 and 100 lx than at 0.01 lx or at 0.0001 lx (dark control).

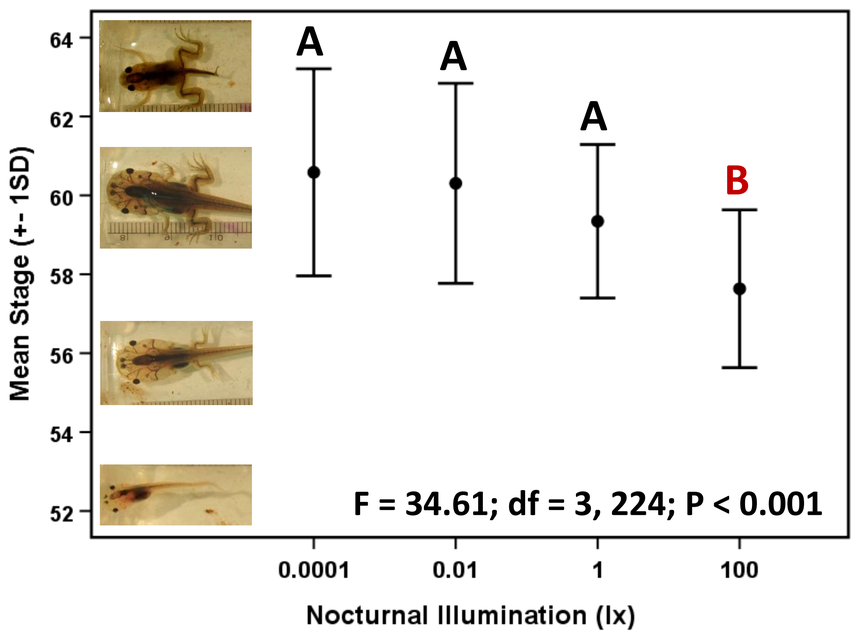
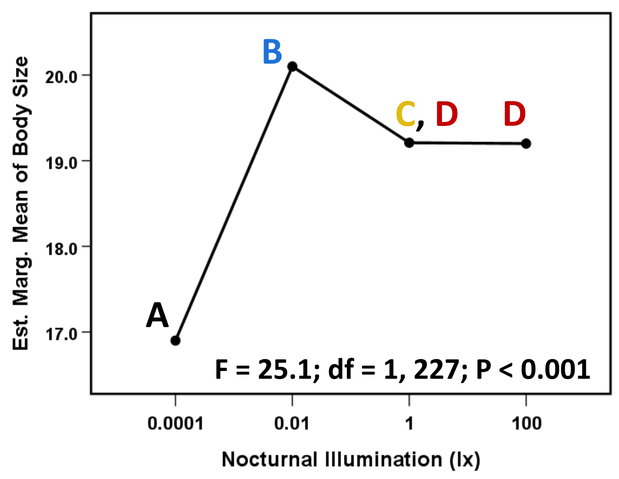


Figure 4: Larval development (stage) was significantly delayed in larvae reared at 100 lx compared to the dark control and all other levels of ALAN.



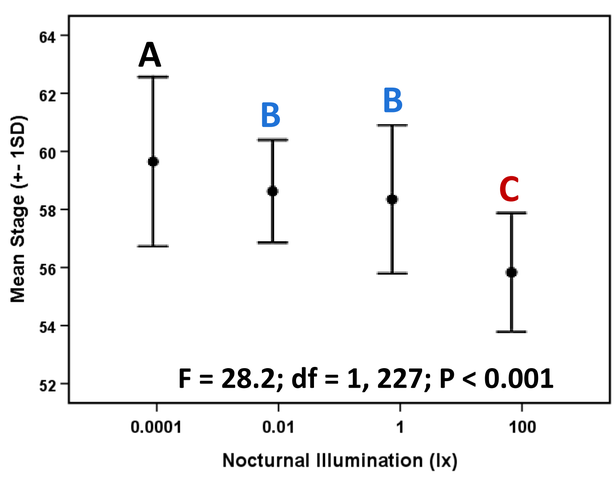


Figure 5: Under fluorescent lighting in a previous experiment, larval body size was significantly greater and development (stage) was significantly delayed at all light levels compared to the dark control. Additionally, even the lowest levels of ALAN increased growth and delayed development.

CONCLUSIONS

Moderate, ecologically relevant, amounts of LED artificial lighting can increase growth in tadpoles. Higher intensities of LED ALAN can slow development in tadpoles. In a previous study, we found that fluorescent ALAN had a more pronounced effect at lower illuminations compared to this current study. Fluorescent and LED lighting appear to impact growth and development differently but a direct comparison within a single experiment would be necessary to determine the specific effects of each lighting type on growth and development of tadpoles.

Literature Cited:

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