Artificial light at night found to cause stunting and shorter metamorphic phase in toads

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Common Indian Toad. Bufo melanostictus. Credit: L. Shyamal/Wikipedia

A pair of researchers with Case Western Reserve University in the U.S. has found that artificial light at night (ALAN) causes stunting and shortens metamorphic duration in toads. In their paper published in

Proceedings of the Royal Society B, Kacey Dananay and Michael Benard describe their study of the American toad living under artificial lighting conditions and what they learned by doing so.

In recent years, a lot of studies have focused on the impact of light introduced artificially at night on animals that live in impacted areas. But as Dananay and Benard note, most such research has centered on a single stage of life. They were curious about the impact of ALAN on creatures that undergo profound changes as part of their life cycles. The American toad, for example, experiences a metamorphic phase as it grows from a swimming tadpole into a hopping toad. To learn more, they constructed an artificial environment, added toads, and studied what happened.

The artificial environment consisted of multiple artificial ponds situated in areas where night lighting could be controlled. The researchers introduced toads and watched as they progressed from eggs to tadpoles to adults under a variety of light conditions. In comparing the toads with those raised in naturally unlit areas, the researchers found that they experienced a shorter metamorphic phase. They also found that given the choice, the toads would inhabit only darker ponds.

In a secondary experiment, the researchers studied toads in an artificial indoor environment that allowed for 24-hour lighting conditions. In so doing, they found that toads responded to the ALAN conditions by continuing to be active during what would normally be their night instead of resting. Such toads, they found, grew more slowly into smaller than normal adults, possibly as a result of their nearly nonstop activity. They also found that juvenile toads that had been exposed to ALAN during their larval stage also demonstrated an increase in activity, even if they were allowed to live as juveniles without ALAN conditions.

The researchers conclude by suggesting their experiments show that the impact of ALAN has a direct, as opposed to indirect, effect on toads and

likely other animals. They note also that such effects can persist throughout the various stages of life.

More information: Kacey L. Dananay et al. Artificial light at night decreases metamorphic duration and juvenile growth in a widespread amphibian, *Proceedings of the Royal Society B: Biological Sciences* (2018). DOI: 10.1098/rspb.2018.0367

Abstract

Artificial light at night (ALAN) affects over 20% of the earth's surface and is estimated to increase 6% per year. Most studies of ALAN have focused on a single mechanism or life stage. We tested for indirect and direct ALAN effects that occurred by altering American toads' (Anaxyrus americanus) ecological interactions or by altering toad development and growth, respectively. We conducted an experiment over two life stages using outdoor mesocosms and indoor terraria. In the first phase, the presence of ALAN reduced metamorphic duration and periphyton biomass. The effects of ALAN appeared to be mediated through direct effects on toad development, and we found no evidence for indirect effects of ALAN acting through altered ecological interactions or colonization. In the second phase, post-metamorphic toad growth was reduced by 15% in the ALAN treatment. Juvenile-stage ALAN also affected toad activity: in natural light, toads retreated into leaf litter at night whereas ALAN toads did not change behaviour. Carry-over effects of ALAN were also present; juvenile toads that had been exposed to larval ALAN exhibited marginally increased activity. In this time frame and system, our experiments suggested ALAN's effects act primarily through direct effects, rather than indirect effects, and can persist across life stages.