Artificial light at night causes stress and disturbs reproduction of common toad during breeding period

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Abstract

Since the last century, the terrestrial globe is facing a "global decline of biodiversity": its sixth mass extinction. Such losses are considerable, as they may have profound consequences on ecosystem's function. Among these, amphibians are particularly affected in terms of population size and diversity. The global Amphibian Assessment revealed that one third of amphibian's species are currently threatened with extinction. Several anthropogenic factors have been identified likely to contribute to such a decline, but one of the currently fastest growing, +6% increase per year, is nocturnal artificial light at night (ALAN). ALAN, resulting from cities development, industrialization and transport infrastructures, is a worldwide phenomenon, as 18.7% of the Earth surface is exposed to brightness levels higher than natural thresholds (Gaston et al., 2013). ALAN leads to alterations of photoperiod, the main driver of daily and seasonal rhythms synchronization. As a consequence, it may affect individual's behavior and physiology by altering processes, such as endocrine regulation, metabolism, motor activity and foraging rhythm. In a previous study, we showed a 75% decrease motor activity of common toads (Bufo bufo) exposed to ALAN, which could impact their reproductive behavior (Touzot et al., submitted). Here, we experimentally exposed breeding male toads to three low realistic intensities of ALAN (0.01, 0.1 and 5 lux) and measured the effects on stress level, testosterone and fertilization rates. After twelve days of exposure, corticosterone levels significantly increased when light intensity was above 0.1 lux. Moreover, male pairing success, exposed to ALAN, was delayed. Finally, at 5 lux, toads testosterone rate dropped by about 10%, which triggered a drastic reduction (25%) of the fertilization rate. Those results may have a major ecological impact on the reproductive success at populations scale, emphasize the impacts of ALAN on organisms and bring novel insight into the mechanisms involved in amphibian's global decline.

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