The Effect of Chronic Exposure to Artificial Light at Night on the Development & Fecundity of Manduca sexta

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Northeastern United States populations of pollinating hawkmoths are in long-term decline or have been locally eradicated. Artificial light at night (ALAN) is a hypothesized contributor; however, no firm link between ALAN and population declines of any moth species currently exists. In this study, sublethal effects that may cause ALAN-induced population declines were investigated by measuring the impact of lifelong exposure to ecologically relevant ALAN on the development and reproductive potential of the hawkmoth, Manduca sexta. Manduca sexta were reared under identical daytime conditions. Nighttime conditions were either darkness (0 lux) or ALAN with a specific combination of correlated color temperature (CCT) (2700K, 3000K, 3500K, 4000K, or 5000K) and illuminance (1, 10, or 100 lux) to evaluate both spectral distribution and intensity. One-way ANOVA and Tukey's method was used to determine significant differences between test group responding variables. Manduca sexta exposed to greater than 1 lux developed significantly slower and obtained a lower pupal mass resulting in significant decreases in female egg production and male testicular volume. Sperm count significantly decreased in seminal vesicles of males exposed to any light combination other than 2700K at 1 lux, which correlated to a decrease in female oviposition and fertilized eggs. Consequently, only the ALAN combination of the lowest CCT (2700K) and illuminance (1 lux) tested did not exhibit a significant negative impact on both development and reproductive potential compared to control. Therefore, outdoor lighting should be 2700K or less, dimmed, and equipped with shields to prevent light from spilling into surrounding wildlife areas.

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