European Commission

Science for Environment Policy

LED lighting changes grassland spider and beetle communities; dimmers and timers may reduce the impact

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The influence of light-emitting diodes (LED) on grassland invertebrate communities has been assessed in a recent study. White LEDs increased the total abundance and changed the species of spiders and beetles recorded. Dimming lights and switching lights off during the middle of the night were the best ways of reducing the effects on beetle and spider numbers.

LEDs are fast replacing conventional means of outdoor lighting. From a 9% share of the global lighting market in 2011, LED lights made up 45% of the market by 2014 and are expected to reach 69% by 2020. Their greater energy efficiency means they are more cost effective and can help reduce carbon dioxide (CO_2) emissions. However, their impact on the environment and on human health has raised concerns.

The blue light wavelength emitted by the commonly used white LED bulbs can impair sleep and can also affect the natural circadian rhythms (internal body clock) of organisms. They may also affect organism navigation, reproduction (e.g. moths) and behaviour (e.g. foraging in bats). Conversely, LEDs may also help mitigate the ecological impacts of lighting as they allow greater flexibility in the use of lighting. For example, by altering light intensity, dimming and switching lights off when demand is low.

This study carried out a three-year field experiment to investigate the effects of LEDs on species of spider and beetle within a previously unlit area of grassland. The researchers also assessed different lighting strategies designed to mitigate the impacts of LED light. A total of 24 plots were lit at night comprising four different lighting treatments (six plots for each treatment as well as six unlit control plots). Treatments included high intensity white LED light, LED street lighting dimmed by 50%, LED street lighting both dimmed and switched off between midnight and 4am and amber LED lighting, which has a similar spectral intensity to conventional low pressure sodium street lighting. Invertebrates were sampled using pitfall traps for a total of three days and three nights during May, July and September each year.

A total of 5 180 individual invertebrates were collected during sampling, representing eight families of spider and 14 families of beetle. Spider abundance was higher under high-intensity white, amber and dimmed LED lights compared to non-lit plots in both day and night, indicating that spiders attracted to lit areas at night remained there during the day.

When dimmed LED lights were switched off in the middle of the night, these effects were not observed. For beetles, white and dimmed white light increased their abundance after the second year of the study, both during the day and night. Dimming lights and switching lights off during the middle of the night reduced these effects. Of the different light treatments, high intensity white (HIW) had the biggest impact on beetle and spider taxa, affecting the abundance of three beetle and four spider taxa.

Continued on next page.

Source: Davies, T.W., Bennie, J., Cruse, D., Blumgart, D., Inger, R. & Gaston, K.J. (2017) Multiple night-time LED lighting strategies impact grassland invertebrate assemblages. *Global Change Biology*, DOI:10.1111/gcb.13615.

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Altering the abundance of species can interfere with the balance of species interactions. Top predators such as the spider *Trochosa ruricola* also increased in abundance during the experiment. This suggests that LED lighting could have impacts throughout the food chain, as increased numbers of predators will have knock-on effects on prey populations.

Dimming LEDs by 50% and using less ecologically damaging wavelengths reduced the number of taxa affected from seven to four. Overall, dimming lights and switching lights off between midnight and 4am were the best way of reducing the ecological impacts of LEDs, although the abundance of two species was still higher under this treatment.

The researchers say the study is the first to compare the ecological impacts of different lighting regimes on invertebrates and adds to a growing body of evidence of the potential negative environmental effects of LED lighting. Overall the study has shown that predatory invertebrate species can cluster under brightly lit areas. The researchers say the results indicate that LEDs may have major impacts on communities of ground-dwelling invertebrates, particularly in areas of high light use, such as roadside verges, which also act as important refuges and dispersal habitats in human-dominated landscape. While lighting management strategies can reduce these effects, avoiding the use of lights is the only way to prevent negative consequences, particularly within ecologically sensitive areas.