European Commission

Science for Environment Policy

Artificial light at night — the impact on plants and ecology

06 May 2016
Issue 455
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Artificial light — such as street lighting and passing car headlights — has an impact on plants. A new study suggests there could also be broader implications for the interactions of herbivores and pollinators. The study highlights that disrupting seasonal light cues with artificial light has far-reaching effects, including: mismatches in timing with herbivores; altering the development of agricultural crops; inhibiting flowering in wild species; decreasing periods of darkness necessary for plant repair from environmental pollutants; and causing barriers to nocturnal pollinator species.

Source: Bennie, J., Davies, T.W., Cruse, D. & Gaston, K.J. (2016). Ecological effects of artificial light at night on wild plants. *Journal of Ecology*. 104(3): 611–620. DOI:10.1111/1365-2745.12551

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Light is a vital requirement for plants: it is necessary for photosynthesis, for information (i.e. when to bud, flower, germinate, etc.) and for their growth form. Natural light varies daily and seasonally. Artificial light sources interrupt that natural cycle — and may disrupt both the plants and the ecology they support. These manmade light sources are concentrated along road verges and hedgerows, in gardens and in urban environments, which may represent a significant and potentially hitherto overlooked threat. A new European-funded[1] study poses the following questions: 1. How much artificial light is there in the environment? 2. How do plants sense light? 3. How do plants respond to artificial light at night?

Artificial lights sources (e.g. street lighting, vehicle headlights and faint 'skyglow'[2]) vary in intensity, duration and spatial distribution. In this study, these sources were compared using a measure of intensity (illuminance, measured in units of lux) and distance from source. For example, the leaves of a tree adjacent to a street lamp may be exposed to up to 100 000 lux (a value comparable to daylight), yet roadside vegetation may experience only around 50 lux. Illuminance is a useful proxy for the biological effects of light when information on the spectral power distribution of light is also available.

Plants have different behavioural responses to different wavelengths of light — with flowering, germination and photosynthesis being associated with exposure to different parts of the visible light spectrum. Photoreceptors in plants use light to sense information about the season and even the time of day, which controls germination, growth and shade avoidance, for example.

Researchers have carried out a review of the evidence on the physiological effects of artificial light and its disturbance to the daily and seasonal patterns of plants and plant–animal interactions. For example, it is well documented that artificial light can prolong the retention of leaves in an urban environment and initiate early onset of bud burst in the spring, thus increasing the risk of exposure to frost and pathogens. Studies have shown that agricultural crops such as soya (*Glycine max*) and maize (*Zea mays*) are affected by their proximity to artificial light, which leads to changes in their development, for example growing rapidly but failing to flower. The wild plant species *Lotus pedunculatus*, produced 10% to 25% fewer flower heads under simulated street lighting, which in turn led to reduced numbers of the aphid *Acyrthosiphon pisum*.

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To cite this article/service: "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.

1. The research leading to this paper was funded by the European Research Council and the European Union's Seventh Framework Programme.

2. 'Skyglow' refers to ambient light pollution generated when artificial light is scattered in a dome above lit areas such as cities and out-of-town shopping centres.

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Road traffic pollutants include ozone, which has been shown to have severe effects on vegetation, including damaging foliage. Periods of darkness can be critical for plants to repair and recover from environmental stresses such as these; therefore, disturbing this natural cycle with artificial light may impede recovery and increase the risk of foliar injury in plants. Experiments with constant artificial light, equivalent to a fluorescent street light adjacent to a roadside verge, resulted in increased rates of foliar damage due to ozone in three clover species.

Lastly, the study explored some of the complex interactions between plants and animals under artificial light. This included the disruption of the life cycle of the moths *Mamestra brassicae* and *Operophtera brumata*, leading to potential mis-matches in timing between egg hatching and spring bud-burst in host trees. Pollinators may also be affected by artificial light, including nocturnal and diurnal pollinators, with potential outcomes including both a higher concentration of active pollinators and a decline in pollination rates. In the tropics, where bats play a role in both pollination and seed dispersal, networks of streetlights may act as a barrier to these processes and therefore long-range gene-flow.

The researchers stress that there has been little recent research into the impacts of artificial light on wild plants but recommend that any future study should be assessed in the context of other environmental stressors such as eutrophication, climate change, invasive species, chemical pollution and habitat fragmentation. They also suggest that the impact of the combined effect of multiple stressors should be investigated if progress is to be made in understanding and predicting impacts at the level of the whole plant, population, community and ecosystem.

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