

The Ecolight Project

The University of Exeter's Environment and Sustainability Institute (ESI), based at its Penryn Campus in Cornwall, is conducting one of Europe's leading research projects into the impact of artificial lighting on plants and invertebrates specifically and, more broadly, on the environment.

Environment and Sustainability Institute (ESI)

www.exeter.ac.uk/esi

The ESI's Director, Professor Kevin J Gaston, is leading a team of researchers whose aim is to meet the unprecedented demand for better data. Financial pressures, new technologies and a richer understanding of the impact of natural-light cycles on many organisms mean local governments worldwide are now in a position to decide to install lighting that does the least environmental harm, while providing the necessary benefits at minimal expense.



ECOLIGHT is leading the way in providing the improved evidence-base on which such critical decisions depend.



The sky at night

Life on earth has evolved under natural cycles of light and darkness: night and day, the phases of the moon and changes in day-length throughout the year. Artificial light is now a common feature of the night-time environment, but little is known about the effects on wildlife populations and on ecosystem structure and function. Artificial lights illuminate the environment directly, but also contribute to artificial sky glow. This phenomenon – artificial light which is scattered and reflected back to earth by the atmosphere – obscures our view of starlight and moonlight, and may also have more profound consequences.

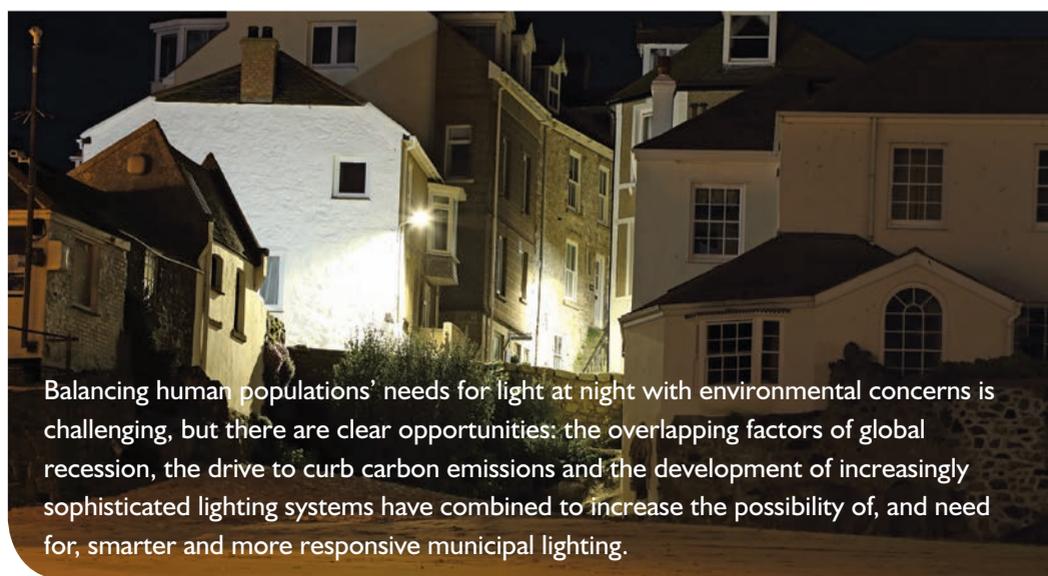


Predictable sky brightness and patterns of starlight and moonlight provide organisms with a lunar clock and celestial compass by which to synchronise activities. Foraging, predation and migration, among other behaviours, are all variously dependent on light intensity. Ordinarily, night brightness is highest when the moon is full and above the horizon, lowest when the moon is new. Although much more work is needed, our research – which encompasses a wide range of approaches, including experiments, field observation and analysis of satellite imagery – has begun to uncover the impact of longer periods of night brightness on the behaviour of a wide range of organisms.



How much light do we need?

Night-time satellite images first showed, in the 1970s, the extent to which our planet was artificially lit. Since then, human activity, economic growth and the need for transport has been associated with increases in artificial lighting's effects. We have developed methods for detecting changes in light pollution using satellite images, and modelling high-resolution 3D maps of light in urban areas to simulate how networks of street lighting may restrict the movements of nocturnal animals.



Balancing human populations' needs for light at night with environmental concerns is challenging, but there are clear opportunities: the overlapping factors of global recession, the drive to curb carbon emissions and the development of increasingly sophisticated lighting systems have combined to increase the possibility of, and need for, smarter and more responsive municipal lighting.

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Upsetting the balance

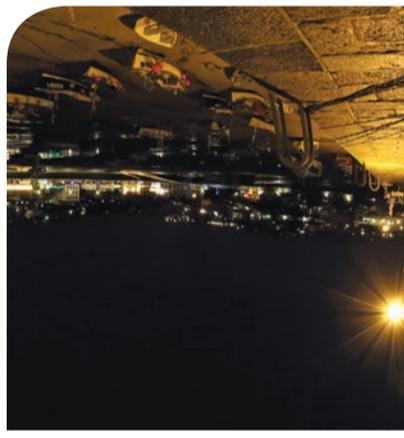
ECOLIGHT has not only been keen to investigate artificial light's effects on organism behaviour, but to determine, too, whether and how it alters the composition of ecological communities (the relative abundance of species). Our research has shown for the first time that street lighting (which grows globally by an average 6% a year) can result in communities containing more predatory and scavenging organisms than unlit communities.



This has potentially important consequences for the structure of food webs. At the same time, even low levels of light have an impact on plants and may have hidden effects, structuring ecosystems from the "bottom up". Disentangling effects of light at different levels in the food chain, from plant to predator, and at different spatial scales, from road verges to the global scale, is a key challenge.

What next?

One of ECOLIGHT's tasks is not just to answer previously unasked questions and so improve understanding, it's also to pull together disparate findings to suggest potential ways forward. Broadly, to reduce the impact of artificial light pollution requires one or more of five potential actions being taken. Maintaining natural unlit areas is arguably the simplest; prevent areas from being lit at all and this helps cut night-time light pollution (although artificial sky glow remains a problem, even tens of kilometres away from urban areas).



It's also possible to illuminate areas for shorter, or more user-defined periods, and technology is also now capable of delivering lighting with reduced trespass (lighting which illuminates only what it's meant to). Where lighting is installed and unmovable, the options exist to change its intensity and its spectrum, both of which have profound but differing consequences for a wide range of plants and animals. To identify the relative merits of these alternatives and make recommendations for their implementation will form the core of our continuing research efforts.



The ESI

Based on the University's Penryn Campus, near Falmouth, the ESI is an interdisciplinary centre leading cutting-edge research into solutions to problems of environmental change. It has been funded by the ERDF Convergence Programme (£22.9m), and the South West Regional Development Agency (£6.6m), with significant support from the Higher Education Funding Council for England (HEFCE).



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Photography: Cover image created by Dr Jonathan Bennie with data from the National Oceanic and Atmospheric Administration (NOAA). All other images by James R. Duffy, Delphine Jones, Matt Jessop.