



Pilgrim
Trust

LIGHT POLLUTION IN THE UK

RESEARCH FOR POTENTIAL FUNDERS

Emma Wells

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Introduction

While various organisations are engaged in efforts to understand and mitigate the effects of light pollution, the multifaceted nature of the effects of light pollution has sometimes led to a disjointed approach to awareness-raising and mitigation. Nevertheless, evidence of the effects of light pollution on biodiversity, and astronomical observation and everyday enjoyment of the night sky, is sufficient to suggest a compelling case for philanthropic involvement. This research seeks to address who is involved in reducing light pollution in the UK; what do interventions to reduce light pollution look like; and how can philanthropy support the reduction of light pollution in the UK?

I first introduce my research questions and explain the methodological approach of this study: interview guides and online desk-based research. I then introduce the four phases of my research design and discuss the limitations of this approach.

Secondly, I summarise the problems caused by light pollution in the UK. Although I focus on the harmful impacts of light pollution on biodiversity and visibility of the night sky, I also briefly review the evidence of the dangers of exposure to artificial light at night on human health, and the relationship between excessive lighting practices and climate change.

Thirdly, I present a discussion of the organisations active in light pollution in the UK. This discussion is supported by a visual representation of the organisations and their relationships to one another. Wildlife and dark sky organisations are compared on the size and number of organisations, and the extent to which they collaborate with other light pollution organisations. The role of the commercial light industry is also discussed.

Fourthly, I present a summary of the range of interventions occurring globally to reduce light pollution. These interventions are grouped into six categories – research and databases, guidance and legislation, dark sky certification, and outreach, events and campaigns – and their potential application to or expansion in the UK are discussed through the lens of the potential for philanthropic support.

Lastly, I present my recommendations for philanthropic organisations interested in funding an intervention to reduce light pollution. I recommend supporting a long-term vision of national legislation to address light pollution, but in the immediate term, philanthropy could fund a campaign to encourage Local Authorities to adopt a comprehensive strategy to reduce local light pollution. This

lobbying campaign should both set out the positive impacts of reducing light pollution in terms of cost savings and reduced CO2 emissions, and create dedicated best practice guidance for Local Authorities.

Methodology

Research Questions

1. Who is involved in reducing light pollution in the UK?
2. What do interventions to reduce light pollution look like?
3. How can philanthropy support the reduction of light pollution in the UK?

Expert Interviews

Early in the research process, I identified experts across a range of backgrounds with an interest and experience in light pollution, who could be contacted for interview. Many of the connections were made thanks to introductions by experts I had previously interviewed. Over the first half of the project, I interviewed five of these experts.

The experts interviewed comprised:

- The director of a charitable trust.
- A lighting industry professional.
- An animal migration author and campaigner.
- An advocacy officer for a wildlife charity.
- A dark skies campaigner.

Interview guides for all experts included the following questions:

- What is your background and interest in light pollution?
- What do you see as the biggest challenges in addressing light pollution?
- What organisations have you worked with to address light pollution?
- How and when do different organisation in the light pollution space work together?
- What do you think is the best strategy for addressing light pollution?
- Which organisations should campaigners be targeting to get action on light pollution?
 - e.g., Local Authorities, Government, Businesses, Individual residents
- What arguments/evidence do you use to persuade people of the importance of addressing light pollution?

These conversations informed phases 1–3 of my research, both by directing my evidence search to new areas, and by providing background information on organisations and initiatives which was not available online.

Lastly, the interviews informed phase 4 of my research, which centres insight and analysis. Talking to people across the spectrum of light pollution work provided an opportunity for me to contrast and compare views against each other, considering where those from different organisations had different perspectives, and what might account for those differences.

Although interviewing a single representative from five different types of organisation is not sufficient to draw conclusions about the differences between organisations, the insights from this comparison directed my subsequent research and informed my own understanding and analysis.

Research Design

Phase 1: Understanding light pollution

For the first two weeks I researched:

- 1) The effects of light pollution
- 2) How and to what extent practical interventions (beyond simply turning off lights) reduce the harms caused by light pollution

The effects and extent of light pollution informed chapter 2, and the practical interventions are presented in the first section of chapter 4.

Phase 2: Understanding the organisations involved in addressing light pollution in the UK

Through desk-based research and expert interviews, I produced a visual overview of the organisations involved in light pollution in the UK (figure 1), followed by a discussion of the findings.

To frame the visual overview and discussion, I used the information I gathered through phase 1, particularly the separation I identified between dark skies (astronomy and heritage) and wildlife (biodiversity).

Phase 3: Understanding the gaps in UK light pollution interventions

To understand the full range of interventions which can be applied to reduce light pollution, I expanded the scope of my research to include activities (and organisations) beyond the UK. These interventions are displayed in appendix 1.

Including international examples helped me to identify gaps in the interventions run in the UK. I then discuss possible reasons for the gap by posing questions such as:

- Is there no actor with the resources to apply the intervention?
- Is there insufficient support from the government?
- Does the legal/political structure prevent the intervention?

I then assess whether I think this intervention would be effective if applied to the UK. Information gained through phases 1 and 2 of the methodology is applied to help answer these questions.

Phase 4: Applying findings to address light pollution in the UK

Finally, I use my findings from phase 3 to assess the potential for philanthropic organisations to support work which reduces light pollution in the UK.

Limitations

Websites are often not well-maintained due to the lack of funding or full-time paid staff and other priorities. I utilised my expert interviewees as much as possible to fill these gaps and used a range of sources, including policy documents, physical books and journal articles to gain as much information on light pollution organisations in the UK as possible.

This project was only six weeks long, so I did not have time to conduct lots of expert interviews. With a longer project timeline, I would have conducted interviews with several people, each from a range of organisation types and analysed these transcripts as primary data. This approach would help me to develop a deeper understanding of the landscape of organisations and their different framings and perceptions of light pollution. To mitigate this, the five people I did speak to were from a range of organisations (dark sky, wildlife, local campaign, commercial, philanthropy).

Clearly, the table of interventions presented in chapter 4 could have been much longer. International examples included in the table were mostly run by organisations mentioned in the book 'The End of Night' by Paul Bogard (2013), as it was difficult to find examples of what were often small-scale interventions in other countries without speaking to light pollution experts based there. Most of the interviewees I spoke to focused on events and organisations in the UK, except for DarkSky International (IDA), which was mentioned by all interviewees.

For most interventions, I also found it difficult to obtain information which quantified their cost and impact. This was partly because those organisations running the interventions did not appear to run monitoring or evaluation activities alongside their work and did not publish cost data.

Context

Introduction

This report aims to help grant-makers and others understand how to address light pollution. As light is not inherently a pollutant, the term “light pollution” can cause confusion, but it is best understood as unnecessary or excessive light at night. This chapter explains why unnecessary light at night is a pollutant by examining the negative effects it has on wildlife and the night sky. It also considers the emerging concern of artificial light’s impact on human health, as well as the environmental effect of unnecessary energy consumption.

Wildlife

Most species of wildlife are thought to be affected by light pollution, but the specific way animals are affected varies widely between species. Artificial light can cause gene deregulation (Touzot et al., 2021)¹, alter breeding behaviour (Touzot et al., 2020)², decrease melatonin production affecting metabolic processes (Grubisic et al., 2019)³, unbalance predator-prey interactions (Gomes, 2020⁴), decrease species richness (Mena et al., 2021) and generate cascading effects within ecosystems (Fleming and Bateman, 2018).⁵ The boxes below introduce some specific research areas and key studies.

Insects: the bug apocalypse

Estimates suggest around a third of insects attracted to artificial light sources at night die before morning, either through exhaustion or because they become easy targets for predators (Eisenbeis, 2006; Frank, 2006; Yoon et al., 2010)¹. A recent study in Southern England found that caterpillar populations declined by 52% in areas with streetlights (Boyes et al., 2021).

¹ [Transcriptome-wide deregulation of gene expression by artificial light at night in tadpoles of common toads - ScienceDirect](#)

² [Artificial light at night alters the sexual behaviour and fertilisation success of the common toad - ScienceDirect](#)

³ [Sustainability | Free Full-Text | Light Pollution, Circadian Photoreception, and Melatonin in Vertebrates \(mdpi.com\)](#)

⁴ [Orb-weaving spiders are fewer but larger and catch more prey in lit bridge panels from a natural artificial light experiment \[PeerJ\]](#)

⁵ [A plea for a worldwide development of dark infrastructure for biodiversity – Practical examples and ways to go forward - ScienceDirect](#)

These insect deaths add up. A 2009 paper (Eisenbeis and Hänel, 2009) estimated that 100 billion insects died in Germany each year as a direct result of attraction to artificial light sources. This indicates that light pollution may be a driver of the “catastrophic [insect] population collapse”¹ observed over the last two decades. Some estimates predict up to 40% of insects will go extinct within the next several decades, with severe cascading effects for other wildlife in the ecosystem (IPBES, 2019; Sánchez-Bayo & Wyckhuys, 2019).

Aquatic life

Light pollution also affects aquatic wildlife such as fish. Light pollution from coastal cities harms seafloor ecosystems (Sordello et al., 2022). 22% of coastal regions are exposed to artificial light at night (Davies et al., 2014) and light from cities affects animals on the seafloor in neighbouring stretches of coastline (Ayalon, Rosenberg et al., 2021). Melatonin production is inhibited in fish even at the lowest level of one lux, disturbing their circadian rhythm (Brüning et al., 2015), and normal prey-predator interactions are modified by illumination of the water at night (Czarnecka, 2019).

Birds

Artificial light at night attracts and disorients birds, causing them to collide with buildings more often. At least 100 million birds die in the United States each year as a result of these building collisions (Loss et al., 2014). A recent study (Doren et al., 2021) found that halving the number of windows lit-up at night decreased bird collisions by eleven times during the spring migration and by six times during the autumn migration.

Flora: pollination & photosynthesis

Plants are affected by light at night directly, and indirectly by the effect of light upon the species (often insects) which pollinate them. Light triggers plants’ photoreceptors (which plants use to detect light) causing a plant to flower earlier and photosynthesise more, which can be overwhelming and create a reactive type of oxygen that kills the plant (BBC, 2023).

Indirectly, a study in Oxford found that in the presence of streetlighting, across 28 varieties of flowering plants, 70% of all moths (key pollinators) observed were drawn away from the plants, towards the streetlights (Macgregor et al., 2016).

Dark Skies

The Science of Skyglow

Ściężor (2019) argues that the “main problem [associated with light pollution] has become the sky glow caused by the uncontrolled emission of light to the sky.”⁶

Skyglow is the orange haze above cities that obscures celestial objects from view. It is partly caused by the reflection of light off surfaces (such as pavements or signs) towards the sky, but it is mostly caused by sources which emit light at or above the horizontal, channelling light directly out from the city into surrounding areas and the night sky.

This diffusion effect is made worse by “low cloud cover”⁷ as “water droplets and other particles in the air [including pollutants] scatter the light around”⁸.

Consequently, skyglow can also be observed tens, and sometimes hundreds, of kilometres from the urban light source which causes it. In England, where towns and cities are relatively close to rural areas and nature reserves, skyglow can also frequently be observed (though the effect is less intense) in rural areas.

The effects of skyglow on wildlife are not well understood. Most light pollution studies on wildlife have looked at the effect of localised light such as streetlights or illuminated buildings. However, the effect skyglow has on astronomy and enjoyment of the night sky is self-evident.

Dark Skies: effects on astronomy and night sky heritage

Astronomers were the first to identify light pollution as a problem around the middle of the 20th Century. They noticed their observations were affected by skyglow.⁹ Even without light pollution, the most advanced astronomical facilities could not be based in Britain because the weather and atmospheric conditions are not conducive. Although light pollution has not severely affected professional astronomy in the UK, the future of British amateur astronomy is threatened by light pollution.

As well as bringing joy to amateur astronomers themselves, evidence to a select committee on astronomy and light pollution commented on the close ties that exist between amateur and professional astronomers and the contribution of amateur astronomers to the activities of professionals, as well as their crucial role

⁶ [10.4467_2353737XCT.19.084.10863 \(1\).pdf](#)

⁷ [besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2664.2012.02212.x](#)

⁸ [What Is Light Pollution and How Is It Harmful? \(webmd.com\)](#)

⁹ [Light pollution as an environmental hazard \(sciencemag.org\)](#)

in “showing the wider public the wonders of the night sky”.¹⁰ As stars and other celestial bodies have become less visible due to light pollution, 61% of the UK population now live in areas with “severe light pollution”, meaning they cannot see more than ten stars at night (CPRE, 2020)¹¹.

Many dark sky advocacy groups emphasise the aesthetic or even spiritual value of the dark sky and its power to awe humans and inspire art. Dark Sky International refers to the loss of visible stars as the loss of “our night sky heritage”:

“Experiencing the night sky provides perspective and inspiration, and leads us to reflect on our humanity and place in the universe. The history of scientific discovery and even human curiosity itself is indebted to the natural night sky.”¹²

It is important to note that there are no residual effects of light pollution. Light pollution is entirely caused by the lights that are switched on at that moment in time: as soon as lights are switched off, they no longer contribute to light pollution. The quality of the night sky is not affected by light pollution, only its accessibility, that is, how many people can view the stars today.

This makes light pollution an easy fix, in that damage from light pollution does not accumulate over time and there is no “tipping point” beyond which the night sky is permanently damaged. However, this can also be a barrier to action, as the issue is not perceived as “urgent”, despite its effects on people and wildlife today.

Other Effects

Human Health

The potential effects of light pollution on human health are under-researched. A BBC Future article (2016) summarised the evidence as a “suspicion” which “has emerged recently”. More recently (2023), the House of Lords Science and Technology Committee published a report on “the effects of artificial light and noise on human health,” which concluded that light is a “neglected pollutant” which causes significant harm to human health. The director of Radiation,

¹⁰ For example, an amateur astronomer might observe a sudden brightening of a star and inform a professional astronomer who subsequently co-ordinates telescopes in both hemispheres to investigate further.

¹¹ [Star Count 2020 shows 61% live in areas with severe light pollution - CPRE](#)

¹² [Light pollution reduces our night sky heritage | DarkSky International](#)

Chemicals and Environmental Hazards Directorate at the UK Health Security Agency commented that the Agency wants to “work with other bodies to expand that [evidence] base”, but current evidence was not yet good enough to carry out a cost-benefit analysis, as is possible with noise pollution.

Most studies on the effects of artificial light on humans have so far been laboratory-based. The evidence base is too weak at the moment for scientists to conclude if results are clinically significant. The World Health Organisation (WHO), American Medical Association (AMA) and European Commission have all issued calls for more research on the health effects of light pollution.¹³

The link between light at night and biodiversity loss has already been established. But the impact of biodiversity loss on human health is also well established: the risk of infectious diseases increases, food systems are damaged endangering our nutrition, and the discovery of new medical drugs is threatened (Adebayo, 2019). This indirect effect on human health is often overlooked in discussions of light pollution.

Energy consumption & climate change

Turning off lights reduces energy consumption, and so energy costs. As lighting has become more efficient, so cheaper, particularly through the introduction of LEDs, the UK is paradoxically introducing more lighting, limiting the cost and energy saving potential of new lighting technology. About 15% of global electricity consumption and 5% of global greenhouse gas emissions can be attributed to lighting (Delgado, 2022). This means turning off unnecessary and excessive lighting has the potential to significantly reduce global emissions.

Conclusion

This report focuses on the effects of light pollution on wildlife and dark sky visibility. On wildlife, because the potential impacts of light pollution on the UK’s biodiversity are well-established through research, and on dark sky visibility because in the UK this is where light pollution campaigners are most active.

¹³ [11a747e4edd6614b871ca16b13f54bf07b43.pdf \(semanticscholar.org\)](https://www.semanticscholar.org/paper/11a747e4edd6614b871ca16b13f54bf07b43)

Organisations

This chapter provides an overview of the organisations which are active in light pollution advocacy and interventions, and an analysis of how they fit together. Figure 1 offers a visual overview of the key organisations discussed in this chapter.



Figure 1: overview of the key organisations involved in light pollution.

Most of the organisations in figure 1 frame light pollution as a problem because of its effect on the quality of the dark night sky, rather than because of its effect on biodiversity. This difference is due in part to dark sky organisations being one step fewer removed from the problem of light pollution than wildlife organisations. While dark sky organisations see excessive light as a pollutant in itself, for wildlife organisations, light is not inherently a problem – it only becomes a problem when we understand the harmful impact which light has on animal and plant species.

Wildlife

Light pollution was first framed, starting in the 1950s, as a problem for astronomers and those who valued the aesthetics of the dark sky at night. The link between light emitted at night and reduced visibility of the stars is clear and intuitive; it does not require a large body of evidence. By contrast, light pollution was not understood as a problem for wildlife until the 21st century (Longcore & Rich, 2004), and scientific evidence is needed to demonstrate that light causes harm to animals. For many species facing decline, there are other better-understood, high-profile causes which are known contributors, such as global warming, habitat destruction or chemical pollutants. Charities have limited funds, so will prioritise these better-known causes, which the public are already aware of, and for which there is a larger evidence base.

Furthermore, the current body of scientific evidence on the impact of light pollution only covers around 160 species (Gibbens, 2023).¹⁴ There are plenty of species for whom we do not know the effects of light pollution, because not enough studies have been conducted. For example, the RSPB is focused on landscape conservation and stopping climate change because the links between this and restoring bird populations are better established and already understood by the general public.

Light pollution can also affect different species differently, making it difficult to make broad claims about its aggregate effects on all wildlife. One study of North American bird species found that 47 out of 140 species became more abundant as light exposure increased, probably because it improves their foraging capability (Wilson et al., 2021)¹⁵. Though this of course then has the potential to

¹⁴ [Want to help wildlife? Turn off your lights. \(nationalgeographic.com\)](https://www.nationalgeographic.com/science/2023/08/turn-off-your-lights-to-protect-wildlife/)

¹⁵ In [Frontiers | 11 Pressing Research Questions on How Light Pollution Affects Biodiversity \(frontiersin.org\)](https://www.frontiersin.org/journal/10.3389/fenv.2023.1121212), but when you follow the link through it's about noise pollution's effect?

disrupt the rest of the ecosystem by disturbing normal predator–prey dynamics (Bennie, 2018)¹⁶. Sensitivity to light at night also differs between species, meaning some are more sensitive to light pollution, and therefore under more of an urgent threat from it, than others.

This is part of why collecting evidence relevant to light pollution is essential. It helps to quantify the scale of the effects of light pollution, as well as the range of its effects, from across a number of different fields, including astronomy, biodiversity and health studies.

Research and Guidance

Although both the organisations DarkSky International (IDA) and the Campaign for Dark Skies (CfDS) focus on dark skies in their campaigning work, they also collate scientific research on the effects of light pollution from multiple fields of study, not just skyglow and astronomy. CfDS publishes a twice-yearly newsletter which summarises developments and progress in light pollution policy and campaign work across the world, as well as recent scientific studies. IDA publishes an annual “state of the science” report, which distils the content of academic papers related to light pollution, from a wide range of fields, into a summary which is accessible to non-scientists. Since 2014, IDA has also collaborated with the Germany-based “Loss of the Night Network” to keep an “Artificial Light at Night (ALAN) research literature database” up to date. The database can be searched by theme (animals, ecology, human health, planning, skyglow, review, lighting) or by publication date.

Butterfly Conservation UK funds research, sometimes involving light pollution, to understand and prevent the decline of butterfly and moth species. However, as it does not have an outreach or campaign arm, the charity does not channel this research into influencing policy or behaviour change. Conversely, CPRE has conducted research to inform its wider campaigning, such as mapping work in 2015 to identify dark skies and landscapes that need to be protected and approved, and a survey of local authority approaches to lighting in England in 2019. Most of its research either directs its own campaign work or is used to produce light pollution guidance to help others take action, such as its guide on how to use statutory guidance to tackle nuisance lighting.

¹⁶ [Artificial light at night causes top-down and bottom-up trophic effects on invertebrate populations - Bennie - 2018 - Journal of Applied Ecology - Wiley Online Library](#)

The commercial lighting industry has also published guidance related to light pollution. The Institute of Lighting Professionals (ILP) has produced a guidance note for 'The Reduction of Obtrusive Light', as well as producing a guidance note in collaboration with the Bat Conservation Trust which advises planners and developers how to design lighting which minimises disturbance to local bat populations.

Dark Sky Organisations

Figure 1 shows that dark sky organisations active in the UK range in remit from the international DarkSky International (IDA) to local dark sky groups, astronomy societies, and National Parks.

IDA is a large international organisation based in the US, with more than 20 chapters outside the US, covering five continents in total. It is the best-resourced organisation campaigning against light pollution, with partners including National Geographic, Discovery, NASA, National Parks UK, and the Smithsonian Institution. The team comprises twelve permanent staff, a board of directors which is advised by four committees, and delegates and advocates who represent IDA's work in different parts of the world. The committees include a technical committee which advises on emerging issues of outdoor lighting practices, an International Committee which advises on how to support the global community of dark sky champions, the Dark Sky Places Committee which advises on dark sky certifications, and the Dark Sky Awards Committee which reviews the nominations and selects winners for annual awards.

The UK branch focuses on raising awareness and protecting dark skies through the DarkSky certification program. More than 200 places internationally have received this certification which is intended to incentivise the community, park or protected area to preserve and protect dark skies through responsible lighting policies and public education outreach programmes. Seventeen of these places are in the UK: eight in England, five in Scotland, three in Wales and one in Northern Ireland.

Aside from these international-level interventions, many local-level organisations in the UK are working to reduce light pollution. For example, many Areas of Outstanding Natural Beauty (AONBs) and National Parks in the UK are concerned by light pollution and active in implementing local interventions to reduce light pollution in their area. These local groups allow dark skies advocates to have conversations at the local authority level and go into schools and communities to

educate individuals and effect behaviour change in this way. For example, Northumberland, Exmoor, North York Moors, Yorkshire Dales, Cumbria, South Downs, and most recently the High Weald, all run dark sky events to raise awareness and celebrate their unpolluted night skies. This localised focus is absent from the wildlife arm of light pollution advocacy in the UK.

Although organisations such as The Wildlife Trusts have local chapters across the country, I could not find any reference to light pollution on their websites. Dark skies have organisations campaigning for and implementing changes in a localised way, which wildlife does not, and these organisations collaborate, sharing knowledge and best practice for interventions at this local level.

As discussed, although skyglow may affect wildlife, the focus for most wildlife charities – perhaps following the strongest evidence source at the moment – is on how localised light affects nearby species within their remit (i.e., moths and butterflies, bats, or invertebrates for the three wildlife organisations identified in figure 1). However, for those organisations for whom preserving and restoring dark skies is the principal aim in and of itself, their focus is on reducing skyglow. Although reducing the amount of localised light pollution – which is essential for wildlife affected by light at night – will reduce skyglow, the most effective way to reduce sky glow is by targeting light sources emitting light at or above the horizon. In this way, the focus of dark sky advocates and wildlife advocates are slightly different.

Their geographic focus can also be different: dark sky organisations usually focus on restoring dark skies to rural landscapes such as national parks or AONBs. They are active in some urban areas – such as the group “Dark Sky London”, or the “Urban Night Sky Place” certification offered by DarkSky International (which has so far only been awarded to areas in the US), but the vast majority focus on the countryside. One interviewee commented on the challenge of changing urban residents’ perception of the dark sky movement as an aesthetic concern confined to those in the countryside, rather than another part of the wider UK environmental movement.

Despite these differences in focus between dark sky and wildlife organisations, collaboration has occurred across the divide.

Collaboration and Networks

Most collaborations between different light pollution organisations occur when an opportunity arises to influence national-level policy. In recent years, this

opportunity has arisen in the All Party Parliamentary Group (APPG) “Ten Dark Sky Policies for the Government” (2021) policy plan and in efforts to include light pollution targets in an amendment to The UK Environment Act (2021).

Regarding the policy plan, although the APPG itself is composed entirely of MPs and lords, over 170 individuals and organisations provided evidence to its consultation for its “Ten Dark Sky Policies” plan. 18 organisations were also recognised by name for their support on the APPG’s Plan including CPRE, DarkSky International, the Campaign for Dark Skies (CfDS), the Institution of Lighting Professionals (ILP), as well as a number of National Parks, Areas of Outstanding National Beauty (AONBs) and local Astronomy Societies.

On the wildlife side, Buglife, the invertebrate charity, coordinated much of the effort to include light pollution in the amendment to the Environment Act, including providing a briefing to peers. However, according to interviewees, dark sky organisations networks were also involved to allow light pollution organisations to present a “united front” on all this high-level policy.

I identified two light pollution network organisations operating in the UK, both of which are “dark sky” networks. The first is the Campaign for Dark Skies (CfDS), a campaign group founded in 1989 by the British Astronomical Association. CfDS is now a network of more than 140 volunteer local officers who typically work at a local level to persuade local councils and organisations of the benefits of responsible lighting¹⁷. They issue a newsletter twice a year on active campaigns, events and recently published studies on light pollution. The CfDS committee includes many astronomers, but also lighting professionals and a lawyer.

The second network I identified is the UK Dark Sky Discovery Partnership, a collaborative forum between the UK’s protected landscapes and national organisations with a stake in lighting or dark skies protection, such as CfDS, CPRE and the Institution of Lighting Professionals (ILP). Its website gives information on events and places to view the night sky, as well as links to astronomy resources and speakers.

The Lighting Industry

As demonstrated by the involvement of lighting professionals in both dark sky networks, and the ILP’s publication of unobtrusive and bat-friendly lighting

¹⁷ “Responsible lighting” in this report means lighting which is not unnecessary or excessive.

guidance notes, the lighting industry has become increasingly involved in dark sky-friendly lighting design and products in recent years. Lighting professionals concerned by light pollution have set up several companies in recent years which focus on the delivery of responsible lighting solutions. In the UK, two companies which focus exclusively on projects concerned with light pollution include “Dark Sky Lighting”, which specialises in the supply of IDA compliant and dark sky-friendly lighting solutions to help prevent light pollution, and “Dark Source”, a responsible lighting design studio. Lighting awards have also been given to dark sky-friendly commercial projects in recent years.

In 2022, the Build Back Better Awards gave a gold award to the lighting of Plas Y Brenin activity centre in Snowdonia and gave a green award to a project which used red public lighting to create a bat “superhighway.”

The Society of Light and Lighting, part of The Chartered Institution of Building Services Engineers, hosted a conference on Responsible Outdoor Lighting at Night in 2022 with sessions on the impact of light pollution, best lighting practice, and legal aspects. Lastly, if approved by the Technical Committee, dark sky-friendly lighting fixtures can receive a “seal of approval” from DarkSky International. 97 companies currently participate in this initiative.

Health and Climate Change

The final group of actors, which are notably absent from Figure 1, are those covering the health and climate change framings of light pollution discussed in chapter 2. As scientific research on the impact of light pollution on human health is still emerging, the evidence base is not yet strong enough to motivate health-focused organisations to have active campaigns to reduce light pollution in the UK. Nevertheless, many light pollution campaigners mention the potential harmful health effects in their summaries of the problems of light pollution.

While some people become convinced of the need to act on light pollution by the biodiversity argument, others are persuaded by the potential human health effects, by the aesthetic loss of dark skies, or by the link to climate change. Many of the people I interviewed saw this diversity of motivation as increasing the opportunity to convince people of the importance of addressing light pollution, which explains why “health effects” is often mentioned (typically very briefly) on the websites of organisations working on light pollution. However, a greater body of evidence is needed to persuade companies and national or local government to change their policies on the basis of human health concern.

The relationships between lighting, energy consumption and climate change are mentioned by even fewer light pollution organisation websites. This may be because climate change does not frame excessive light as a “pollutant”, but rather as a wasteful “practice”, and therefore it does not fit neatly within the light-as-pollutant perspective of those concerned about the harmful impact of excessive, unnecessary light on health, biodiversity, and dark skies.

In conclusion, there is a clear distinction between primarily wildlife-focused and primarily dark skies-focused organisations, with no health-focused or climate-focused organisations currently working on light pollution. Most organisations working on light pollution in the UK are dark sky focused, and a significant number of these are dedicated to reducing light pollution as their sole campaign. Despite these differences, dialogue and collaboration do occur between different light pollution organisations, particularly when the opportunity for significant, national-level change arises. There is also interest and the necessary expertise within the commercial lighting industry to support this from a supply side.

Interventions

Appendix 1 presents a range of international interventions and activities designed to reduce light pollution. It includes a discussion of the categories of intervention, their potential application to or expansion in the UK, and the role philanthropy could play in supporting this.

Research & Databases

A significant challenge to reducing light pollution, which was also noted by several interviewees, is the popular perception that decreasing light increases crime. Research on the relationship between street lighting and crime is mixed (Uttley et al., 2018)¹⁸, yet the College of Policing (for England and Wales) currently classifies "increasing the levels of lighting on the street or in other public spaces" as an intervention which has a "very strong" impact on crime.¹⁹ More research is needed to develop firm conclusions about the relationship between crime and light.

Furthermore, almost all existing research on street lighting and crime compares "standard" street lighting (all lights on at full capacity for the full duration of the night) to no street lighting (where lights are turned off for the whole night). In practice, Local Authorities across England have adopted a range of responsible lighting interventions, including dimming lights, installing lights which turn on only when they sense movement, turning lights off for only a few hours of the night or changing the lighting colour. More research is needed on a mix of street lighting strategies which reduce light pollution.

Even when stakeholders acknowledge that the evidence is inconclusive, they may cite fear of crime as a justification for not reducing street lighting. At a council meeting in Surrey in 2021, six months after the murder of Sarah Everard which sparked protests and renewed policy focus on violent crime against women, attendees were debating a motion to roll-back the street lighting switch off between the hours of 12am and 5am which had been in place since 2017 (Armstrong, 2021). A Residents' Association leader in attendance explained that fear of crime, and in particular fear of violent crime among women, was enough justification in itself for keeping on public lighting.

¹⁸ [The science of street lights: what makes people feel safe at night \(theconversation.com\)](https://theconversation.com/the-science-of-street-lights-what-makes-people-feel-safe-at-night)

¹⁹ <https://www.college.police.uk/research/crime-reduction-toolkit/street-lighting>

"I accept it may well be right there's no correlation between lights being on and crime or accidents. But it is a question of perception and people's feelings; if they feel unsafe there is a problem, we need to deal with it."²⁰

Reassurance from Local Authorities that they are monitoring crime rates whenever they change lighting helps to reassure the public, potentially reducing fear of crime and so opposition to reduced street lighting. Research by CPRE, The Countryside Charity (2015), found that while 91% of councils which switch off street lights are monitoring crime statistics, this dropped to only 51% of councils which dim their streetlights. This is a problem both because valuable data which could strengthen the evidence base on lighting and crime is not collected, and secondly because residents may be more opposed to reduced lighting at night if they do not feel their safety is being monitored.

Lastly, research has been essential for quantifying and conveying the extent and intensity of skyglow. The World Atlas is the source for the much-quoted figures of 80% of the world's population, and more than 99% of Europeans living under light-polluted skies.²¹ The CPRE star count uses citizen science to quantify skyglow. The results are less robust than the methodology used for World Atlas, but they serve the dual purpose of helping to quantify skyglow in easily understandable terms, as well as using this activity to raise awareness of the problem of skyglow. 4,000 people took part in the 2023 star count.

Lastly, research is an important first step in generating awareness of the negative effect of light pollution on biodiversity, as this is not as intuitive as the effect on the quality of the night sky. It can help developers and policymakers understand how to address this effect on wildlife in practical terms. Research can then be used to inform guidance and legislation.

Guidance & Legislation

Generally, guidance falls into two categories. One for developers on how to minimise light pollution and its negative effects, and another for individuals to understand and use legislation to take legal action on local cases of light pollution. As there are no significant restrictions on light pollution in planning guidelines or legislation in the UK, the value of guidance for developers is

²⁰ [Surrey council resists call to turn street lights back on at night - Surrey Live \(getsurrey.co.uk\)](https://www.getsurrey.co.uk)

²¹ [The new world atlas of artificial night sky brightness | Science Advances](https://www.science.org)

contingent on the developers already accepting the importance of reducing light pollution.

In the case of guidance for individuals, this relies entirely on adequate legislation already existing. Although the UK Clean Neighbourhoods and Environment Act (2005) makes “exterior light emitted from premises so as to be prejudicial to health or a nuisance” a criminal offence which the Local Authority can take legal action against, according to Defra’s own guidance note, “the statutory nuisance regime is not an appropriate tool with which to address light pollution per se”²². Indeed, as CPRE notes in its guidance on how to use statutory nuisance legislation to address incidents of light pollution:

“this law doesn’t tackle all forms of light pollution, only incidents of particularly bad lighting from some types of premises which cause people real nuisance.”

The guidance also notes that, even if it is a nuisance, public streetlighting is exempted under the law, along with lighting at harbours, airports, goods vehicle operating facilities, and public transport centres. The nuisance lighting must also specifically harm a person’s enjoyment of their land, meaning lighting which only affects common land cannot be complained about under the law.²³

National-level legislative campaigns have had more success in other European countries. In Germany, the Insect Diversity Act limits light pollution on the grounds of the harm it causes to local biodiversity. The campaign to include light pollution monitoring and targets in the UK Environment Act – which largely focused on the damaging effect of light at night on local biodiversity – was unsuccessful. The UK Government has also been repeatedly criticised for failing on its pledge in the 2018 25 Year Plan to halt wildlife decline by 2030 and ultimately overseas net biodiversity gains. The watchdog for the 25 Year Plan, the Office for Environmental Protection (OEP), found in January 2023 that of the 23 environmental targets examined, the government was demonstrably on track on none of them (Guardian, 2023). Consequently, focusing exclusively on biodiversity protection as the grounds for introducing light pollution legislation may not be the most fruitful strategy in the UK.

²² [Light-Nuisance-JPEL_2006.pdf \(statutorynuisancesolutions.co.uk\)](#) in “Guidance, para. 90”

²³ [light-pollution-as-a-statutory-nuisance-a-how-to-guide.pdf \(cpre.org.uk\)](#)

The Spanish light pollution legislation for the Canary Islands is motivated specifically by the need to protect dark sky quality for the benefit of professional astronomical activities on the Islands. As the UK does not have the atmospheric conditions necessary for professional astronomy activity, this approach is unlikely to be successful in motivating light pollution legislation in the UK.

On the other hand, Croatia, France and South Korea have all adopted legislation motivated by a more multi-faceted concern about the effects of light pollution. For instance, the French decree states that the purposes of the regulations are “to prevent, limit and reduce light pollution, including excessive disturbance to persons, fauna, flora or ecosystems, causing energy wastage or preventing observation of the night sky”.²⁴ Two years after the French decree, the amount of artificial light at night was found to have decreased by 6%²⁵. Although this decrease cannot be attributed causally to the decree, it is nevertheless a promising indication of the potential impact that dedicated national legislation can have.

Aside from requiring monitoring of light levels and setting national targets – as the unsuccessful amendment to the UK Environment Act proposed – there are other mechanisms by which national legislation can reasonably expect to reduce light pollution. Options include:

- Banning the sale of certain light fixtures such as up-turned floodlights or products which are not dark sky accredited.
- Limiting the percentage of light which can be emitted directly into the sky from an artificial light source.
- Prescribing a minimum percentage of light emitted which must be confined to angles below 14.5 degrees from the horizontal.
- Curfews on outdoor lighting.
- Limits on the colour temperature of light.

Together, these more prescriptive restrictions have the advantage – compared to monitoring national levels of artificial light at night and assessing against targets – of not simplifying the problem of light pollution down to just the amount of light emitted into the sky (or skyglow) – which is what is typically measured by light

²⁴ Article 3, Section I. From [France Adopts National Light Pollution Policy Among Most Progressive In The World | DarkSky International](#)

²⁵ [\[2006.04440\] A Case study of light pollution in France after the change in legislation \(arxiv.org\)](#)

pollution metrics. Instead, they focus on the light-emitting source itself, and therefore its impact on the local environment.

Another alternative is adjusting the planning system. The Korean Light Pollution Prevention Act (2013) categorises all areas of the country into one of four Environmental Management Zones: E1 is the darkest area and E4 the brightest. The Act prescribes a different lighting limit for each zone, with different limits for advertisement and decorative lighting, measured in candelas per square metre (a unit of measurement for luminance or brightness). The limits are applied one hour after sunset and one hour before sunrise.²⁶ This zoning system has also been proposed closer to home with the guidance note on the reduction of obtrusive light published by the UK Institute of Lighting Professionals (ILP) recommending that Local Planning Authorities use lighting limits based on zones in their Development Plans.²⁷

Clearly, philanthropy cannot fund new legislation itself, but if the ultimate aim of funding is to secure legislative change, there are two tracks of approach which could support this effort. On the first track, philanthropy could fund a targeted lobbying effort on policymakers for a national law to regulate light pollution, including gathering experts to draft the proposed law itself. If successful, the impact of such an intervention is likely to be very large. However, the risk of failing to secure legislative change is significant. The second track adopts a lower-risk approach of raising public support for action on light pollution with the intention that public pressure results in legislation in the long term. At a lower scale of impact, increased public awareness could also result in the public pressuring their Local Authority and local business owners to emit less light pollution.

An alternative to top-down national legislation enforced by Local Authorities – potentially via the National Planning Policy Framework – is an increase in support and guidance to local planning authorities. There could be two key aspects to this approach:

1. Set out the positive impacts of reducing light pollution.
2. Create best practice guidance, including a network for local planning authorities.

²⁶ [Sustainable Lighting Policies The Contribution of .pdf](#)

²⁷ [Guidance Note 1 for the reduction of obtrusive light 2021 | Institution of Lighting Professionals \(theilp.org.uk\)](#)

The first prong would also support Local Authorities in estimating the expected cost savings and reduction in CO2 emissions from adopting a less polluting lighting strategy. In a survey of 21 Local Authorities, CPRE²⁸ found that 95% were motivated to pursue a streetlight switch-off scheme by the energy savings and 91% cited cost saving as a motivating factor. Only 43% of respondents cited light pollution as a factor, indicating that a strategy to improve responsible public lighting at the Local Authority level should clearly communicate the energy and cost saving benefits.

Dark Sky Certification

Most certification schemes target rural areas of notable natural beauty. In the UK, many Areas of Outstanding Natural Beauty (AONBs) and National Parks are already involved in light pollution campaigns: running dark sky festivals, informing the Dark Skies All Party Parliamentary Group Policy Plan and implementing local lighting policies to protect their dark skies.

Although their focus is still mostly more remote, rural areas, a number of dark sky certification schemes have designations specifically for urban areas, or areas close to urban centres. The Canadian Dark-Sky Sites Program has an “urban star park” designation, which acknowledges that “skies are generally brighter than other designations due to nearby urban areas, but are still usable for astronomy”. DarkSky International (IDA) has an “urban night sky place” designation, which recognises “efforts to educate the public on the benefits of proper outdoor lighting that ensures public safety while minimising potential harm to the natural night-time environment.”²⁹ Of the 201 certified IDA dark sky places, only seven fall under this “urban night sky place” designation. In Canada, two of the 27 total certified dark sky sites are urban star parks.

Although the focus of dark-sky certification schemes is typically preservation of “natural” dark skies to protect and enhance the arcadian character of the site, most schemes now have several categories of certification which acknowledge the different motivations for preserving dark skies. Particularly notable is the UNESCO scheme, which has “natural sites” to safeguard nocturnal habitats, “astronomy sites” to protect the view of the night sky, and “heritage sites” to protect archaeological or culture sites created to express humans’ “relationship

²⁸ [Shedding light - a survey of local authority approaches to lighting in England.pdf \(cpre.org.uk\)](#)

²⁹ [Dark Sky Place types | DarkSky International](#)

with the firmament".³⁰³¹ Although only a single town so far, Alqueva in Portugal, seems to have been awarded the designation, the Starlight Foundation (supported by UNESCO and the UN World Tourism Organisation) also runs a Starlight Tourism certification, which acknowledges the value of dark skies to local tourism industries.

It is also notable that all dark sky certification schemes require not only the quality of the dark sky to meet certain standards (i.e., visibility of celestial objects and degree of darkness), but also for these places to coordinate a substantial outreach and public education programme.

The French "Starry Towns and Villages" certification programme coordinated by ANPCEN, a national dark sky organisation, awarded certification to 364 French municipalities (about 1%) in its 2019–2020 round of awards. The scheme is approved by the Ministry of Ecology and Inclusive Transition, with participating towns and villages receiving a rating of between one and five stars depending on the municipality's level of involvement in addressing local light pollution.³² There is no such national scheme of certification in the UK, and the existing international schemes are better suited to encouraging preservation of dark skies over remote rural areas, rather than lowering light pollution in urban areas.

If philanthropy were to fund a national certification scheme for the UK (similar to ANPCEN's in France), this could be paired with a light pollution awareness and guidance campaign for Local Authorities. However, the cost of auditing such a scheme is likely to be high, and would require a well-resourced, national-level organisation with an interest in dark skies to facilitate it. To create lasting change, the scheme should run consecutively for several years to ensure that certified places maintain their efforts to reduce light pollution in the long-term. Lastly, the causal impact of such an intervention on light pollution levels is uncertain, as it is not clear whether the authorities that participate in such schemes are already involved in dark sky work, or if the prospect of dark sky certification motivates them to take an interest and take action where they were not motivated before.

³⁰ [World Heritage Centre – Astronomy and World Heritage Thematic Initiative \(unesco.org\)](https://www.unesco.org/en/whc/themes/whc-theme-astronomy)

³¹ Note that these certified dark skies are not recognised by World Heritage Committee as specific categories of World Heritage cultural & natural properties, since no criteria currently exist for considering dark skies under the World Heritage Convention.

³² [Sustainability | Free Full-Text | Assessment of Citizens' Actions against Light Pollution with Guidelines for Future Initiatives \(mdpi.com\)](https://www.mdpi.com/journal/sustainability/special_issue/Sustainability_Free_Full-Text_Assessment_of_Citizens'_Actions_against_Light_Pollution_with_Guidelines_for_Future_Initiatives)

Outreach, Events and Campaigns

It is notable that all UK-based dark sky festivals identified in this study were held in national parks or AONBs. This may reflect the advantage of rural areas, which already have reasonably dark skies and so visibility of some stars, over urban areas: rural areas can exploit the night sky as a tool in raising awareness of light pollution and inciting action to preserve it. In contrast, London, for example, can never hope to achieve a view of the Milky Way like the South Downs. So, although there are some star-gazing sites in public parks, an appeal to the beauty of the natural night sky is unlikely to be as effective in London as it is in more rural areas. Wildlife is also less visible in and less frequently associated with urban areas, which can again make it harder to impress upon the public the impact of urban light pollution on biodiversity.

In cities and urban areas, where light pollution severely affects the visibility of the night sky, outreach and campaigns which target the biggest polluters may be more effective than those which focus on public awareness raising. The City of London is already conscious of and concerned by the scale of light pollution. In February 2023, the City of London Corporation announced proposals to ask high-rise buildings to observe a lights curfew where they switch off or dim their lights at night. Although the curfew will be compulsory for new developments, for existing buildings, participation would be 'encouraged' but ultimately voluntary. The proposal is billed as dually reducing the effects of light pollution on residents and helping the City of London to reach its carbon net zero target by 2040.³³

In the US, several campaigns ask businesses to reduce the amount of light they emit at night in order to protect migratory birds. In New York, the 9/11 memorial installation, 'Tribute in Light', is composed of two large light beams which shine directly into the sky. Campaigners reached an agreement with the installation's lighting engineers to switch off the installation lights when too many birds become trapped in the light. Several US cities run a campaign called 'Lights Out', which asks local businesses to turn off their lights at night in order to prevent bird collisions. Another arm of Light's Out's work involves collecting and counting dead migratory birds from the pavement in the early morning. The compromise at the Tribute in Light between engineers and local ornithologists is similarly driven in part by the visibility of the problem: the sheer number of birds effectively "trapped" in the beams is obvious from the ground. The effect of light pollution on

³³ [Plans to dim City of London's skyscrapers to save energy - BBC News](#)

birds is highly visible in both these cases, but “European cities are not blighted by mass mortality of [migrant birds] striking illuminated buildings.”³⁴ Although birds in the UK are certainly affected by light pollution, the consequences of this disturbance are not so visible as they are in US cities, and so there is less public awareness of and campaigning against the problem.

Philanthropy could attempt to lobby local businesses to reduce their light pollution, perhaps tapping into their Environment, Social and Governance (ESG) goals in city centres, or pushing the reduced energy consumption (and associated reduced CO2) benefits. However, without public pressure it is difficult to predict how effective such a strategy would be. A lobbying effort against local government in urban areas may be more effective. It is encouraging that the City of London already accepts that light pollution is a problem and considers it in its lighting strategy and design guidance.³⁵ Given the City of London is already aware of and persuaded by the arguments for reducing light pollution, philanthropy could capitalise on this and, utilising the influence of the City, fund a lobbying effort of London boroughs, the Greater London Authority, and local government in other densely populated urban areas beyond the capital.

³⁴ [Nocturnal flight calling behaviour of thrushes in relation to artificial light at night - Gillings - 2021 - Ibis - Wiley Online Library](#)

³⁵

<https://www.bing.com/search?q=lighting+strategy+city+of+london+light+pollution&cvid=5318507df79a40f1b54eaf9b3962a8e4&aqs=edge..69i57j69i64j69i11004.5072j0j4&FORM=NAB01&PC=U531>

Recommendations

Although the lobbying effort to include light pollution targets in the UK Environment Act was unsuccessful, the cases of other (especially European) countries which have introduced some legislation against light pollution are promising for campaigners in the UK. Although biodiversity protection and astronomical activity are, in isolation, unlikely to be sufficient to motivate legislation (as they have in Germany and the Canary Islands respectively), national laws in France, and regional laws in Italy provide optimism that a more holistically motivated, prescriptive approach to reducing light pollution may be achievable. Philanthropy should hold national light pollution legislation as a long-term aim, but concentrate current interventions on light pollution at a more local level.

The UK may be at a disadvantage with its political structure, in that it is not possible to implement more local, regional laws addressing light pollution. Campaigning and public pressure, coordinated by the dark sky organisation Cielo Buio, seem to have been very effective in effecting legislation at this regional scale in Italy. However, philanthropy could fund the development of guidance and an outreach and support campaign aimed at Local Authorities. Such an intervention should both present the cost-benefit case for reducing light pollution (including expected CO₂ reduction and cost savings) and offer guidance on how to implement a responsible lighting strategy which also educates the local community.

The first phase could involve a mapping exercise to identify which Local Authorities are already involved in reducing light pollution and which are aware of light pollution as a problem but have not yet taken action. These Local Authorities can then be supported to improve their lighting strategy and light pollution outreach work, and their experience can be used to inform the best practice guidance outlined above.

Once support for reducing light pollution is increased, then philanthropic investors may want to invest in a lobbying effort to push for national legislation.

Further Options

Research

For philanthropic organisations which consider awarding funding for academic research, there are two significant gaps in the evidence base relevant to light pollution in the UK: public safety and wildlife. Firstly, a more nuanced assessment

which distinguishes between the effects of different types of light pollution reduction strategies (such as dimming compared to total darkness; different timings of dimming) is needed. Secondly, a project similar to the LANTERNS study is needed to support local authorities in monitoring the relationship between light and crime. This may also help to address the increased fear of crime associated with reduced public lighting as the public are reassured that their safety is being monitored. Secondly, more research on the effects of light pollution on wildlife endemic to the UK is needed, as well as accompanying research on the most effective lighting designs and strategies for mitigating these effects.

Dark Sky Place Certification

A philanthropic organisation could fund a scheme similar to the French “Starry Towns and Villages” certification. However, it is not clear whether the impact of such a scheme would be sufficient to justify its significant cost, incurred through an initial publicity campaign to make authorities aware of the scheme’s existence and how to apply, as well as significant administrative and auditing expenses. This intervention may be more effective once the profile of light pollution as an issue has been raised among Local Authorities.

Conclusion

In conclusion, this report has examined the complex issue of light pollution in the UK, highlighting the need for a more coordinated and comprehensive approach to address its multi-faceted effects on biodiversity, astronomical observation, and the overall enjoyment of the night sky.

I first summarised the significance of light pollution, emphasising the adverse impacts it has on biodiversity and visibility of the night sky, alongside consideration of its impact on human health, and its association with climate change. The research questions and methodology were then outlined to provide a framework for conducting the research. Limitations were noted, including the reliance on online sources and the constraints of a six-week timeline, and the scarcity of quantifiable data regarding the cost and impact of interventions. The latter limitation highlighted a need for better monitoring and evaluation practices within the field of light pollution

I grouped into categories a broad range of international interventions to reduce light pollution and analysed these groups according to their applicability to the UK context and compatibility with philanthropic support. In light of this analysis, I made specific recommendations for philanthropic organisations interested in supporting efforts to reduce light pollution. These recommendations include advocating for national legislation in the long-term, and in the immediate and medium-term, funding a campaign to encourage Local Authorities to adopt lighting strategies which are less polluting.

Appendix 1: table of international interventions on light pollution

INTERVENTION TYPE	EXAMPLE	ACTORS	NOTES
DARK SKY PLACE CERTIFICATION	Starlight Tourism Certificate	Starlight Foundation (supported by UNESCO & UN World Tourism Organisation)	Certificate awarded to tourist destinations with very low light pollution.
	Starlight Reserves	UNESCO	Six categories of reserve accommodate a range of reasons for protecting the night sky.
	International Dark Sky Places	DarkSky International (IDA)	Five categories of dark sky places. Minimum criteria include public outreach activities as well as dark sky quality.
	Dark-Sky Sites Program, Canada	Canadian Astronomical Society	Recognises sites contributing to reduction of light pollution, educating the public and liaising with municipalities on legislation. ³⁷ Three types of designation: dark-sky preserve, nocturnal preserve and urban star park.

³⁷ [Dark-Sky Sites Program \[STAGE\] | RASC](#)

	“Starry Towns and Villages” Certification, France	Association for the Protection of the Night Sky and Environment (ANPCEN); Ministry of Ecological Transition ³⁶	Certifies based on actions carried out to improve the quality of night sky and the nocturnal environment.
LIGHTING DESIGN ACCREDITATION & AWARDS	DarkSky Approved Products	DarkSky International (IDA)	Products, companies and projects can be certified. Database of approved products can be searched by company, use, retailer or colour temperature.
	Awards given to responsible lighting projects	Build Back Better Awards, UK	Not specific to light pollution – generally reward innovation in the built environment – but a number of responsible lighting projects have received awards in the past.
RESEARCH & DATABASES	Artificial Light at Night (ALAN) research literature database	DarkSky International (IDA) & Loss of the Night Network	Can search literature by theme (animals, ecology, human health, planning, skyglow, review, lighting) or by publication date.
	Local Authority collaborators’ National Evaluation of	UCL & London School of Hygiene & Tropical Medicine; Funded by	Local Authorities reducing street lighting at night were asked to participate in the

³⁶ [Participate in Starred Cities and Villages and Territories of Starred Cities and Villages > Meeting Bérangère Abba, Secretary of State for Biodiversity, Ministry of Ecological Transition – ANPCEN](#)

	Reduced Night-time Streetlight (LANTERNS) project	National Institute for Health Research (NIHR)	research by providing data on crime rates and lighting changes.
	Rapid Assessment of Lamp Spectrum to Quantify Ecological Effects of Light at Night	Longcore et al.	Describes an approach for a tool which can be updated as more scientific studies of the impact on wildlife are updated. Prototype of tool accessible which ranks by lamp type, the impact on insects, sea turtles, salmon and Newell's Shearwater (a sea bird), or the average impact on wildlife. ³⁸
	World Atlas of Artificial Sky Brightness	Falchi et al.	Quantifies the magnitude of light pollution on a global scale.
	Star Count	CPRE	Quantifies the scale of light pollution across the UK through citizen science: members of the public are asked to participate in the annual Star Count.
OUTREACH, EVENTS AND CAMPAIGNS	Dark Sky Festivals	Northumberland National Park; Exmoor National Park;	Typically comprise events for families, amateur astronomers and members of the public to celebrate. Examples of events

³⁸ [Rapid assessment of lamp spectrum to quantify ecological effects of light at night - PubMed \(nih.gov\)](#)

	<p>North York Moors National Park;</p> <p>Yorkshire Dales National Park;</p> <p>Cumbria (Lake District National Park);</p> <p>South Downs National Park;</p> <p>High Weald AONB</p>	<p>include astrophotography workshops, night walks, art workshops and stargazing sessions, Guest lectures on biodiversity and night sky heritage.</p>
<p>Annual dedicated day to fight against light pollution</p>	<p>Municipality of Varese; La Varese Nascosta (The Hidden Varese)</p>	<p>Intended to sensitise the local population to the problem of light pollution with initiatives in schools and all educational centres in the Municipality of Varese in Lombardy, northern Italy.</p>
<p>“Nurture the night shift” campaign</p>	<p>Buglife, UK</p>	<p>Resources to help individuals (especially children) engage with and protect nocturnal wildlife in their garden.</p>
<p>‘Lights Out Salt Lake’</p>	<p>Tracy Aviary, Utah, US</p>	<p>Residential, commercial or municipal sign-up to turn off or block as many building lights as possible during migration seasons. Other ‘lights out’ campaigns run across North America, including Toronto and Philadelphia.</p>

	Tribute in Light: bird monitor & pause strategy	NYC Audubon, US	When the volunteer monitors count more than 1,000 birds “trapped” in the light beams of the installation, the lights are switched off for 20 minutes to “free” the migrating birds.
GUIDANCE	Light pollution as a statutory nuisance: a ‘how to’ guide	CPRE	A two-page guide for individuals who are affected by severe light pollution to use the UK’s Clean Neighbourhoods and Environment Act (2005).
	Guidance note for the reduction of obtrusive lighting	Institute of Lighting Professionals (ILP)	25-page online document, revised regularly to reflect advancements in lighting technology and changes to international guidance.
	Guidance note on bats and artificial lighting in the UK	Bat Conservation Trust & Institute of Lighting Professionals (ILP)	73-page online document, intended to raise awareness of the impacts of artificial lighting on bats and advise on potential solutions to avoid and reduce this harm.
	Guidance and letter templates for reporting non-compliance to municipal authorities	Cielo Buio, Italy	Detailed instructions and templates for how to report non-compliance through an initial request to the administrator, followed by a notice of complaint and finally a report to the Public Prosecutor’s Office.

	National Light Pollution Guidelines for Wildlife including Marine Turtles, Seabirds and Migratory Shorebirds	Australian Government Department of Climate Change, Energy, the Environment and Water	Include a framework for assessing and managing light pollution impacts on protected wildlife, with specific advice on marine turtles, bats, terrestrial mammals, seabirds and migratory shorebirds.
CAMPAIGNS TO INFLUENCE LEGISLATION	Policy Plan: "Ten Dark Sky Policies for the [UK] Government"	The APPG for Dark Skies	Outlined ten policy recommendations for the UK Government based on consultation with over 170 lighting and light pollution experts.
	(Proposed) Amendment 10, UK Environment Act 2021	Lord Randall of Uxbridge; Buglife (briefing)	The amendment would have introduced light pollution targets and monitoring to the Bill. Though debated in the House of Lords, it was not taken to vote at report stage so did not become part of the Bill.
NATIONAL LEGISLATION	Light Pollution Protection Act 2021	Croatia	Replaces light pollution laws of 2011 and 2015 which were criticised as ineffectual. Sets out maximum permitted values of illumination; prohibits sky beams and colour temperatures about 2200K in ecologically sensitive places; requires submission of

			lighting plans to ensure compliance with the law. ³⁹⁴⁰
Decree on Prevention, Reduction and Limitation of Light Pollution, 2018	France		Outdoor lighting curfews, less than 1% of light emitted directly into the sky, at least 95% of light emitted confined to angles below 14.5 degrees from the horizontal, limits on colour temperature of light.
Law for the Protection of the Astronomical Quality of the Observatories of the Institute of Astrophysics of the Canary Islands, 1988	Spain (Canary Islands)		All ornamental lights switched off at midnight; streetlights dimmed by 50% between midnight and dawn; all street lights must have 0% upper light output ratio (ULOR) ⁴¹
Insect Diversity Protection Act, 2021	Germany		Note that a decree must still be passed before this act becomes law. Draft law contains a ban on floodlights and insect light traps.

³⁹ [Croatia Set To Enact One Of The World’s Most Advanced National Light Pollution Laws | DarkSky International](#)

⁴⁰ [Law on the protection against light pollution. | UNEP Law and Environment Assistance Platform](#)

⁴¹ The ratio of emitted light which escapes upwards from the luminaire.

	Light Pollution Prevention Act, 2013	South Korea	Regions divided into four Environment Zones with different Light Emission Standards for each zone. Failure to comply carries a fine of up to \$10,000.
FEDERAL/MUNICIPAL LEGISLATION	Italian regional laws. E.g. - Piedmont region - Veneto region - Lombardy region	Italy	Fifteen of the twenty Italian regions have introduced a law regulating light pollution.
	US state laws. E.g. - New Hampshire - Florida - Texas - Arizona	United States	At least nineteen states, the District of Columbia and Puerto Rico have laws to reduce light pollution. Some states have also adopted light pollution regulations into their zoning codes. A full summary of different state laws is available here: States Shut Out Light Pollution (ncsl.org)