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# SCIENCE FOR ENVIRONMENT POLICY

## The 'Dark Ecological Network': strategically tackling light pollution for biodiversity and people



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\* Samuel Challéat & Kévin Barré share the first co-authorship of this article

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**Night-time light pollution from artificial sources can disrupt biological processes and fragment habitats.** This study presents a new concept for addressing the problem: a 'dark ecological network'. Its development involves mapping a new system of connected functional zones and corridors where dark can be preserved to help birds, bats and other taxa, and gives people the chance to experience starry skies.

Under the [EU Birds and Habitats Directive](#), EU Member States (MSs) are required to maintain or restore favourable conservation status for species and habitats of EU importance. These legal requirements cover many species sensitive to light pollution, including a number of bat, beetle and moth species. Measures that MSs must establish for these species will, therefore, often encompass action towards effectively reducing light pollution, in particular in areas where these species occur, or where their presence should be restored, with a particular focus on [Natura 2000](#) sites.

The [Pan-European Biological and Landscape Diversity Strategy](#)<sup>1</sup> recognises that ecological networks provide conditions for populations to thrive, therefore, biodiversity conservation requires a landscape approach rather than focusing on individual areas. In addition, the EU's [Green Infrastructure Strategy](#) aims to establish a planned network of natural and seminatural areas that deliver ecosystem services. Current environmental protection approaches, however, focus on day-time activity and material causes of habitat fragmentation<sup>2</sup>, say the researchers behind this study.

Light pollution affects nearly a quarter of global land and 88% of European surface area<sup>3</sup>. Degradation of darkness, even at levels comparable to street lighting shining into a room, affects circadian rhythms, metabolism and sleep in humans and wildlife. Disturbance of daily light cycles impact birds' singing and foraging habits; moths exhibit reduced flight-to-light behaviour in artificially lit locations. Approximately 28% of vertebrates and 64% of invertebrates are nocturnal — impacts



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1. Council of Europe (1996) [Pan-European Biological and Landscape Diversity Strategy](#). In Ministerial Conference *Environment for Europe*, Sofia, Bulgaria, 23-25 October 1995. Council of Europe Press, Strasbourg, 1996.

2. Schroer, S., Huggins, B.J., Azam, C. and Hölker, F. (2020) Working with inadequate tools: legislative shortcomings in protection against ecological effects of artificial light at night. *Sustainability* 12(6): 2551. <https://doi.org/10.3390/su12062551>

on these have cascading consequences for others in the ecosystem. Although challenging, it is, therefore, essential to better understand disturbances caused by artificial light at night (ALAN) and to protect darkness as an environment, say the researchers.

Importantly, the researchers explain that ALAN can fragment habitats, as animals may avoid or be attracted to lit environments. Illuminated areas can be difficult for many bats and toads to pass through, for example. By affecting phenomena such as flowering and fruiting (some grasses flower later under artificial light), ALAN can genetically divide animal and plant populations. Conversely, some creatures such as arthropods and seabirds accumulate in lit areas. By altering birds' migratory paths, this may interfere with access to reproduction sites or mates and migratory stopovers.

The researchers suggest that the dark ecological network's first aim would be to mitigate habitat fragmentation. They argue that increasing unlit areas — or dark refuges — is the best solution. Existing knowledge of ecology, balanced with human needs, should inform lighting strategy. For example, one study suggests bats avoid streetlight at a radius of 50 metres<sup>4</sup>; and turning off public lighting between 00:00 and 04:00 has been found to help grassland invertebrates. Strategic light management should also focus on sensitive bird migration paths and fruit growing areas in spring. To know where to increase unlit areas, the researchers suggest that current knowledge about ALAN effects in relationship to the landscape should be considered — for example, tree cover can intensify ALAN effects on bats.

A holistic, joined-up framework is necessary to reinforce the protection of darkness, while accounting for local specificities, argue the researchers. Existing strategies include designated [International Dark Sky Places](#) and the *French éclairer* juste policy or doctrine<sup>5</sup>, which promotes best practice in urban lighting, but these create a scattering of dark zones. The European Interreg programmes, [Pyrenean Strategy for the Protection and Improvement of the quality of the night environment \(Pirineos La Nuit\)](#) and [Smart Light Hub](#), have stimulated awareness. Indeed, public participation has been crucial in [Houston Audubon Lights Out Action](#) and Réunion Island's [Nights without Light](#), which ask communities to turn off lights to help birds during migration and maiden flights. The proposed dark ecological network could bring together and extend current 'reservoirs of darkness' with corridors, buffer zones and stop-over sites.



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## The 'Dark Ecological Network': strategically tackling light pollution for biodiversity and people (continued)

3. Falchi, F., Cinzano, P., Duriscoe, D., Kyba, C. C. M. et al. (2016) The new world atlas of artificial night sky brightness. *Science Advances* 2(6): e1600377. <https://doi.org/10.1126/sciadv.1600377>

4. Azam, C., Le Viol, I., Bas Y. et al. (2018) Evidence for distance and illuminance thresholds in the effects of artificial lighting on bat activity. *Landscape and Urban Planning* 175:123-135. <https://doi.org/10.1016/j.landurbplan.2018.02.011>

5. This policy, and budget issues, has led to some municipalities switching off public lighting at certain times. However, these actions have been scattered and not co-ordinated.

The researchers endorse participatory development, noting that the network would also restore the experience of darkness, a resource with cultural and symbolic meaning as well as biological effects. By blocking views of starry skies, ALAN contributes to the 'extinction of the experience of nature'. Experiencing nature allows a sensitive understanding of the world and appreciation of environmental issues, they say — therefore, extending this experience is vital in conservation.