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Systematic Map  
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# A substantial evidence base documents how artificial light affects bird movement and distribution across ecological contexts, species, and light characteristics

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**We provide a searchable database of 490 studies demonstrating the effects of artificial light on bird movement, distribution and avian community composition. Many studies are relevant to questions of conservation or management importance, including if/how artificial light affects bird aggregation/mortality (218 studies), its efficacy as a deterrent (228), and its effects habitat selection (88). Fewer studies is available to determine whether birds are attracted to (35 studies) and/or disoriented by (38) artificial light. Why do birds collide with illuminated structures? This question is a knowledge gap, with only 1 study designed to conclusively demonstrate attraction or deterrence. Most studies of orientation (30/38) focused on disorientation, but artificial light may interfere with many other orientation mechanisms, including solar and stellar compasses.**



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## Why is this Evidence Synthesis Needed?

Artificial light at night is rapidly increasing, with many potential conservation and management implications for birds. Many species are known to aggregate around and collide with illuminated structures, and these aggregations are suspected to result from attraction to or disorientation by artificial light. Paradoxically, light is also used to reduce bird mortality and crop damage by deterring birds from airports or farmland and warning them about the presence of obstacles in their flight paths. Artificial light can change bird habitat selection, which could result from both attraction to and avoidance of artificial light. Studies documenting aggregation, deterrence, and habitat selection are typically considered separately, but this study combines these literature bodies and provides evidence on how artificial light affects bird movement, behaviours preceding movement (orientation and alert responses), and distribution.

This Collaboration for Environmental Evidence Systematic Map collates and organizes the evidence that artificial light affects bird movement and distribution. The map summarizes the characteristics of 490 studies and provides a searchable database to identify evidence for specific research questions based on the types of birds, light treatment characteristics, or outcomes measured.

## Main Findings

### *What studies are included?*

A total of 490 studies documented the effects of artificial on bird movement or distribution. The map provides a broad evidence base, with at least one study each for 26 avian orders and 65 countries around the world, but evidence was sparse for South America and its endemic species. At least six studies evaluated each part of the visible spectrum (violet to red), and most studies tested white broad-spectrum white light, but most of these studies did not report the type of lamp, colour temperature, or other spectral characteristics that may influence bird responses.

### *What evidence exists on the effects of artificial light on bird movement, distribution and avian community composition?*

Artificial light has many effects on birds, as evidenced by the 56 response variables that we organized into three categories of behaviour, distribution, and avian community composition. Bird movement behaviour and distribution were recorded in 229 and 372 studies, respectively, but effects of light on bird community composition was only studied five times. Further organization of the 56 response variables into 11 subcategories (e.g. alert response, birds counts, and diversity) allows users to find evidence relevant to specific research or management questions.

### *What evidence exists for specific conservation and management actions?*

We identified bodies of evidence for five subtopics related to conservation or management, including: bird aggregation/mortality at illuminated structures (218 studies), attraction to artificial light (35), disorientation by artificial light (38), the efficacy of light-based deterrents (228), and the impacts of artificial light on habitat selection (88).

## What are the Implications of the Review Findings?

Our Systematic Map provides an evidence base organized into a searchable database to support policy actions and Systematic Reviews. We also identify other conservation and management questions for which little evidence exists. The database can support analyses of how weather and lunar phase affect the likelihood of bird aggregation and mortality at light sources. However, as on-demand obstruction lighting becomes more common, field studies should investigate whether bird mortality is lower at communication towers with no lights compared to communication towers with flashing lights. Why birds collide with illuminated structures needs more experimental research because only one study adequately tested bird attraction to light, and the influence of artificial light on most orientation mechanisms remains unknown. A review of the deterrent efficacy of red and green lasers would help users identify the most effective wavelength for their intended applications. Further tests of UV and violet lasers are needed to determine their potential as deterrents. To determine how the conversion to LED technology will impact bird habitat selection, a review could study how LED lamps affect bird distribution compare to halogen and fluorescent lamps. More research is needed on other common street lamps (e.g. metal halide and sodium vapour).

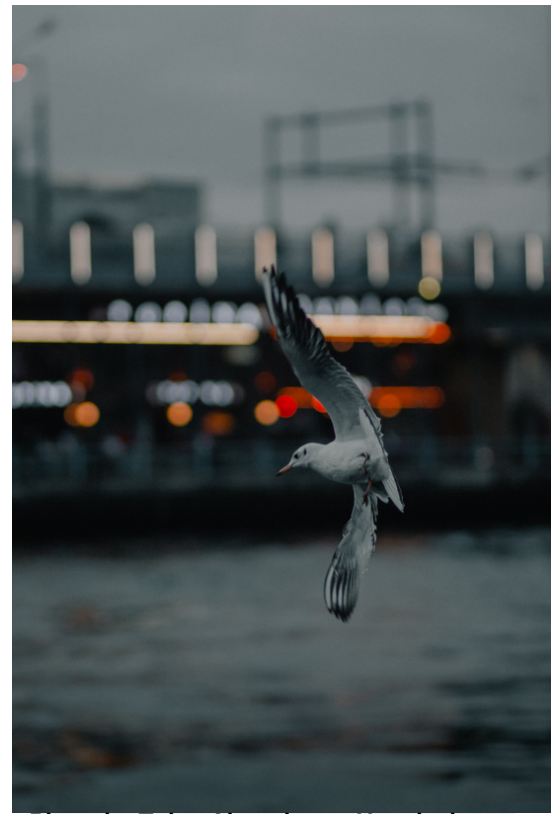


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## Synthesis Time Frame

The review authors searched for studies published up to August 2020. This CEE Systematic Map was published in December 2021.

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