DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

Effects of LED Lighting on Terrestrial Wildlife

Develop knowledge that will allow for the design of effective and safe roadway lighting systems with LEDs (light emitting diodes) that minimize impacts to wildlife.

Environmental

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Project Title:
Effects of LED Lighting on Terrestrial Wildlife

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Task Manager:
Simon Bisrat
Senior Environmental Planner
simon.bisrat@dot.ca.gov

WHAT WAS THE NEED?

Roadway lighting sources that have been in use for the better part of a century or more are rapidly being phased out in favor of light emitting diodes (LEDs). This transformation has been driven by energy efficiency and total replacement of legacy technologies such as low-pressure sodium and high-pressure sodium lamps.

Because the first available LED produced light appearing blue and bright, their replacement of the yellow-orange hues of sodium vapor lighting raised significant concerns among biologists, who recognized adverse consequences of this change in spectral composition to sensitive wildlife.

California Department of Transportation (Caltrans) is increasingly being asked to evaluate these adverse impacts to wildlife when consulting with federal and state regulatory agencies. However, Caltrans' practitioners lack the knowledge on how to evaluate the potential adverse effects and the means on how to minimize any adverse effects.

WHAT WAS OUR GOAL?

The goal of the research is to expand knowledge that will allow for the design of effective and safe roadway lighting systems with LEDs that minimize impacts to wildlife. Guidance materials for evaluation and mitigation of the potential impacts to wildlife will be developed for use by Caltrans personnel.

WHAT DID WE DO?

This research will involve synthesis of existing research and new laboratory and field investigations that fill crucial knowledge

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gaps, development of novel ways to integrate assessment of wildlife impacts into lighting engineering, and development of suggested design practices that can be deployed by Caltrans.

WHAT WAS THE OUTCOME?

The study synthesized known or probable effects of LEDs on wildlife to provide to Caltrans practitioners and regulatory agencies with a common set of information to assess environmental impacts and mitigation methods accurately.

Specific search terms were used across different databases to gather the body of relevant research using specific screening criteria. Discrete studies were extracted from the final eligible literature sources.

Almost all studied organisms were either chordates or arthropods. The most common chordate studies were on development followed by movement with a significant body of research conducted related to animal husbandry. Most arthropod studies were on movement followed by development with a significant number of studies related to mosquito.

Light pollution research can be used to inform the assessment of the effects of LEDs except for specific LED characteristics of flicker and non-Lambertian emittance.

The results showed that mitigation of LED impacts can be achieved by reducing intensity, controlling spill, reducing duration, and controlling spectrum to avoid peak sensitivities of most groups to shorter wavelengths.

Significant variability in photoreceptor sensitivity and flexibility of spectral outputs of LEDs need to be considered for specific affected wildlife species to mitigate adverse impacts from LEDs.

WHAT IS THE BENEFIT?

The benefits of the research would be the protection of sensitive biological resources through the adoption of best management practices for roadway lighting during the conversion to LEDs; and when new lighting is added to unlit areas for safety reasons.

Costs to Caltrans could be reduced through a streamlined regulatory process that reduces uncertainty surrounding impacts to sensitive species based on the best available science. Within this context the results of the proposed research could be used to:

1. Establish significance impact thresholds by intensity and spectrum for species or groups of species;
2. Use generalized impact maps to extrapolate species-specific impact zones from different lighting technologies and configurations;
3. Set procedural triggers for further consultation based on species presence and known lighting impacts; and
4. Establish system-wide lighting design standards as a “no regrets” policy for biological resources impacts.

LEARN MORE

Final Research Report: https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca23-3696-finalreport.pdf