



Science Watch - A Dim Outlook for Fireflies

“This is really important because we have been all wasting our time running around counting flashes, and none of it matters if they are literally next to each other and don’t mate.” – A. Owens

Avalon Owens, an entomologist at Tufts University, Medford, MA, has been studying fireflies for several years and is concerned about their future. “There’s this sense of doom. They seem not to be in places where they used to be,” she said in a recent interview.

Fireflies rely on the night sky to perform their courtship. But artificial light at night (ALAN) has nearly doubled in the last 25 years causing scientists to be concerned about its effects on nocturnal animals, especially insects. Bright city lights get diffused into the atmosphere, illuminating even wilderness areas. As a result, more than 23% of the global land surface now experiences some degree of artificial night sky brightness.



During courtship male fireflies take to the air using their bioluminescent light source to flash a species-specific code to females on the ground. If she is receptive, a female flashes back a precisely timed response, the male alites and mating ensues (see 1997, “*The Lady or the Tiger*,” at <https://www.hras.org/past-sciencewatch-articles>).

But recent studies have shown that ALAN can inhibit flashing females from answering back and patrolling males appear less abundant near artificial lights. Now Dr. Owens and Sara Lewis, a professor also at Tufts, write in the August 10, 2022 issue of the *Royal Society Open Science*, that while some firefly species are shy about mating under illumination, others appear not to care.

Owens and Lewis looked at how ALAN affects mating in four *Photinus* firefly species common to the eastern US. They found that for one species, *P. greeni*, active at dusk, dim artificial light was enough to keep 96% of tested males from approaching a female flashing on the ground.

Next, they tested the effect of dim and bright light at night on mating of pairs of *P. obscurellus*, a nocturnal species that lives in marshes. In laboratory tests dim light had no effect, but bright light, simulating a bright streetlamp, completely blocked successful mating. Many males were observed crawling over females without mating. Tests in the field showed that even dim light negatively impacted the mating success of courting pairs of *P. obscurellus*. Dr. Owens believes they are waiting for the night that never comes.

The results were more encouraging for two other species, *P. pyralis* and *P. marginellus*, that are active at dusk and common to our area. Females of both species were collected from a field, marked and replaced in three areas of the field under different ALAN: dark, dimly lit and brightly lit.

Over several nights they were scored for mating success by noting whether they had received a sperm sac from a male. The researchers found that mating success was not affected under any light condition. “They are just mating left, right and center,” said Dr. Owens. “They do not care at all. To be there in the field and see it is crazy.” However, many of the females, which rarely fly, had moved from a brighter to a darker area, indicating they prefer the shadows.

Few studies like this have been done, but additional data will likely show that many of the more than 2,000 firefly species worldwide are negatively affected by ALAN and other threats. A 2020 worldwide survey conducted by a team of scientists, including Owens and Lewis, identified habitat loss, artificial light, and pesticide use as the three most serious threats to firefly species.

As a first helpful step we can limit a common fall ritual. Fireflies live the bulk of their lives as larvae in leaf litter, under rotting logs, and in moist areas. The larvae devour the gardener's foes like slugs and snails. The magical moments we see only occur in the last weeks of their lives when they are adults. But they won't happen if we rake up the larvae and bag them along with the underbrush and leaves on our property.

Like *P. greeni* and *P. obscurellus*, many species already appear to be severely impacted even by dim light and others may soon find there are no more dark places to which they can move. Insect populations are declining worldwide and ALAN is a likely contributing factor.

Whether we can muster the will to reduce ALAN to save fireflies and other affected nocturnal insects will be the challenge.

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