

CONSERVATION AT HOME

Protecting Fireflies from Pesticides



Fireflies need safe places to hunt, shelter, mate, and overwinter. By eliminating pesticide use, you can help protect the habitats they need to thrive. (Photos: Ken-ichi Ueda, [L] [Flickr CC BY SA 2.0](#); [M, R] Terry Priest, [Flickr CC BY SA 2.0](#).)

Few sights signal the beginning of summer like the flashing of fireflies at dusk. Yet these evening spectacles may be blinking out due to various threats, including habitat loss, light pollution, and pesticide use. Indeed, pesticides are believed to be second only to habitat loss and fragmentation as a cause of firefly declines (Lewis et al. 2020). While research on specific pesticide risks to fireflies is limited, several studies suggest that chronic exposure to commonly used insecticides such as neonicotinoids and organophosphates can harm fireflies. Furthermore, studies on related insects allow us to infer that many pesticides may negatively impact firefly populations. By understanding the firefly life cycle, their specific needs, and the threats they face from pesticides, you can take direct action at home to help conserve their populations.

Fireflies Spend the Majority of their Lives in the Soil

Fireflies, like other beetles, undergo four distinct life stages, progressing from an egg to a larva, pupa, and eventually an adult. Although we typically think of the luminescent adult life stage when we think about fireflies, these animals actually spend most of their lives—up to two years—in the larval stage, hunting for soft-bodied invertebrate prey at or near the soil surface. This is true of flashing species (aka lightningbugs) as well as daytime dark and glow-worm species. Throughout the year, you may have predaceous firefly larvae creeping through your garden soil and leaf litter, eggs and pupae developing underground or in rotting logs, and adult fireflies sheltering under rocks or in shrubs and trees—waiting for the summer mating season.

Pesticides Harm Fireflies

Pesticides threaten fireflies by killing them, changing their behaviors, or eliminating their food sources. Fireflies can be exposed to pesticides directly via application to their habitats, by pesticide drift, by runoff into waterways, or even by eating contaminated prey. Pesticides can also cause subtle yet harmful effects, like behavioral and physiological changes, that may impact firefly reproductive success. Studies have found that exposure to neonicotinoids—well-known for their harm to bees—can destroy their gut cell tissues or lead to changes in firefly behavior, like eating less or failing to build pupation chambers (Pearsons et al. 2021; Wang et al. 2022).

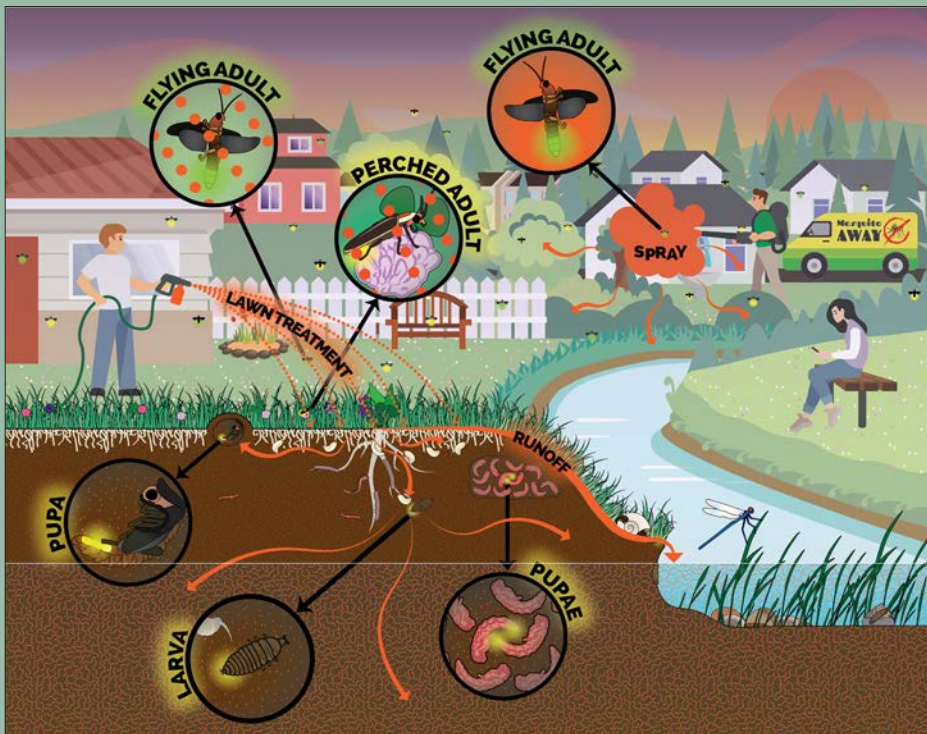
In residential areas, pesticide applications to lawns and landscaping can contaminate soil, harming a variety of valuable soil dwelling invertebrates, including firefly larvae. Hard surfaces in urban landscapes—like roads, driveways, and even lawns—can also transport pesticides to nearby firefly habitats. For example, sampling surveys of urban waterways have found high levels of pesticides, some of

which can impact fireflies (Nowell et al. 2021). Two common pesticide uses in residential areas, mosquito management and broadcast lawn treatments, are particularly risky to fireflies because they occur over large areas and in locations where fireflies are often found.

Home Mosquito Treatments

Many insecticides used in mosquito control treatments are known to be toxic to beetles. Companies that spray for adult mosquitoes at home tend to use pyrethroids, a class of insecticides toxic to most insects. These sprays often target vegetation that may harbor adult mosquitoes—the same areas that provide shelter to adult fireflies. Furthermore, they may be applied at dusk, when mosquitoes (but also fireflies) are most active. Larvicides, which are insecticide treatments applied to standing water to kill mosquito larvae, are also commonly used for mosquito control in residential areas. Some products available for home use, like spinosad and methoprene, might be a threat to fireflies since these chemicals can harm beetles (Galvan et al. 2006; Liu et al. 2016).

Pesticide Threats to Fireflies & Exposure Pathways



Pesticide Threats

Pesticides threaten all firefly life stages by killing them directly, or through indirect effects like changes in their behavior, reduced reproduction, or limiting food availability.

Pesticide Exposure Pathways

Fireflies can be exposed to pesticides in numerous ways, including:

- Direct contact with sprays or residues
- Ingestion of contaminated prey
- Exposure to runoff and contaminated soil

(Figure: Sara Morris.)

Lawn Treatments

Pesticides are commonly used to keep lawns weed and pest free. Lawn treatments that target unwanted insects, mainly beetle larvae (grubs), can contain highly toxic, broad-spectrum insecticides, including pyrethroids, neonicotinoids, and chlorantraniliprole. These chemicals can be deadly to numerous insects, including fireflies. Insecticides, herbicides, and fungicides (often marketed to respond to disease concerns) can also be found in multipurpose fertilizer products. These turf treatments are designed to be broadcast over an entire lawn which could harm any firefly larvae that are present. While research is limited, lawn treatments can have harmful impacts on firefly populations; for example, soils contaminated with neonicotinoids have been shown to have significant negative effects on fireflies (Disque et al. 2019).

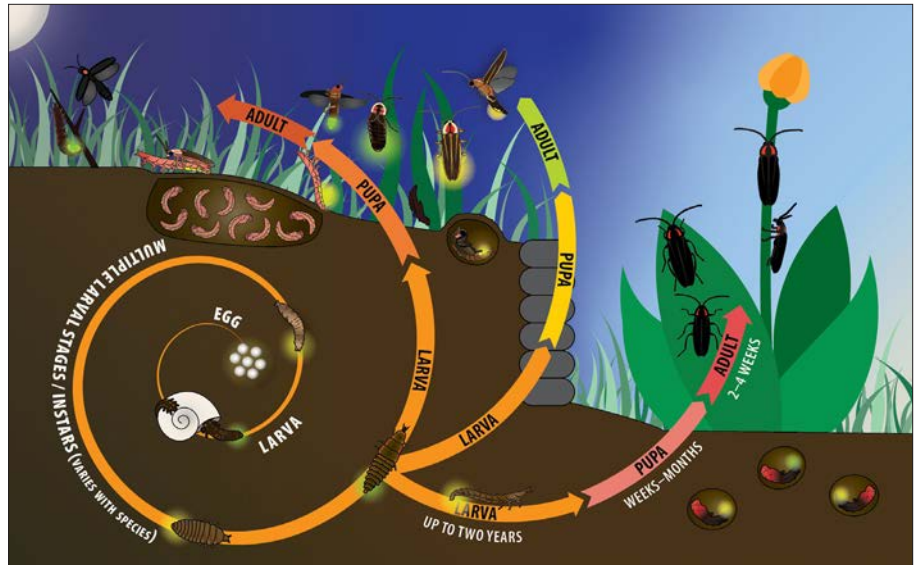
Some herbicides and fungicides have also been shown to cause harm to beetles and other insects. Fertilizers themselves can also harm fireflies. Lower firefly abundance was found in landscapes with fertilizer use in Atlanta (Ridenhour 2012), and in another study, urea fertilizers and ammonium fertilizers killed 27% and 56% of firefly larvae respectively (Lee et al. 2008).

Fireflies Need Safe Spaces

Fireflies need food, shelter, moisture, dark nights, and protection from pesticides. At home, you can provide habitat for fireflies and their prey by planting herbaceous native plantings, leaving leaf litter and downed wood, and encouraging moisture by planting for shade. It is also important to avoid disturbance of the habitats you create. Consider what areas of your yard fireflies might be using during their various life stages, and eliminate pesticide and fertilizer use, since many commonly used garden pesticides harm fireflies. In particular, do not apply highly toxic insecticides, either to the soil or directly to plant foliage. You can take direct action to protect fireflies and their habitats while keeping pests in check by adopting thoughtful, preventative approaches to pest management.

Address mosquito problems before they arise by:

- Dumping standing water from places like buckets and flowerpots, and ensure gutters are not clogged. If you



Fireflies can be found throughout your yard's vegetation and soil. Protecting these from pesticides is important for conserving these species. (Figure: Sara Morris.)

have a pond in your yard, add a waterfall or small pump to keep water moving. When encouraging moisture for fireflies, ensure there is no standing water.

- If mosquitoes are becoming a nuisance often a box fan is enough to keep them away.

When pest or weed issues arise:

- Address the factors causing the outbreak. You can often solve these problems by changing conditions so the pest can't flourish, like ensuring plants are receiving appropriate water and sunlight.
- When management is needed, a variety of cultural and manual methods can be used, like clipping diseased leaves, using water to knock off aphids, or weeding by hand with tools like a hoe or ball weeder. Cooperative Extension offers a number of management options, including others that are pesticide-free.
- We encourage you to view your yard as habitat for fireflies and other invertebrates, tolerate some feeding damage, and revel in the ecological beauty they provide.

Instead of synthetic fertilizers, consider:

- Adding diversity to your lawn, including clover as a nitrogen fixer.
- As needed, use well-timed, light use of compost in the spring, and leave grass clippings on the lawn after you mow.
- If you use an organic fertilizer, be sure to use it only when the grass is actively growing.

Learn More

Firefly Conservation: A Guide to Protecting the Jewels of the Night
xerces.org/publications/brochures/firefly-conservation-guide-to-protecting-jewels-of-night

Smarter Pest Management: Protecting Pollinators at Home
xerces.org/publications/fact-sheets/smarter-pest-management-protecting-pollinators-at-home

Supporting Ecologically Sound Mosquito Management
xerces.org/publications/fact-sheets/supporting-ecologically-sound-mosquito-management

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Firefly larva. (Photo: Katja Schulz, [Flickr CC-BY 2.0](https://www.flickr.com/photos/katjaschulz/).)

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