



Firefly Habitat Certification Guide

Congratulations on taking the initiative to help protect the habitats for some of our most beloved insects - the fireflies. Fireflies are on the decline in many parts of the world. While the specific causes of decline vary by location, many are likely to be driven by habitat degradation and loss, light pollution, pesticide use, and climate change. Your efforts to protect, restore, and enhance habitat will have a long-term impact on the ability of existing populations of fireflies to thrive from generation to generation, thereby preventing them from disappearing completely.

We are trying to save biodiversity.

In this document, we will outline steps you can take to help create and manage habitat, ways to boost biodiversity by planting natives and eliminating invasives, reducing light pollution, placing restrictions on pesticide usage, and raising awareness to benefit fireflies conservation efforts.

We are purposely keeping this guide as succinct and concise as possible so it's easy for users of all experience levels to learn how to certify their habitat. Your unique habitat may require attention that is different from others. If you are certifying a backyard habitat for example, light pollution and pesticide usage may be more of a concern. Whereas someone with a larger tract of land or a public nature preserve may need to do more work to prevent trampling by those using the property recreationally.

This guide will help you decide what actions you need to take to fully certify your property as a Certified Firefly Habitat with Firefly Conservation & Research. While it's not possible to individually certify every property, you are asked to try to satisfy all four criteria as best you can.

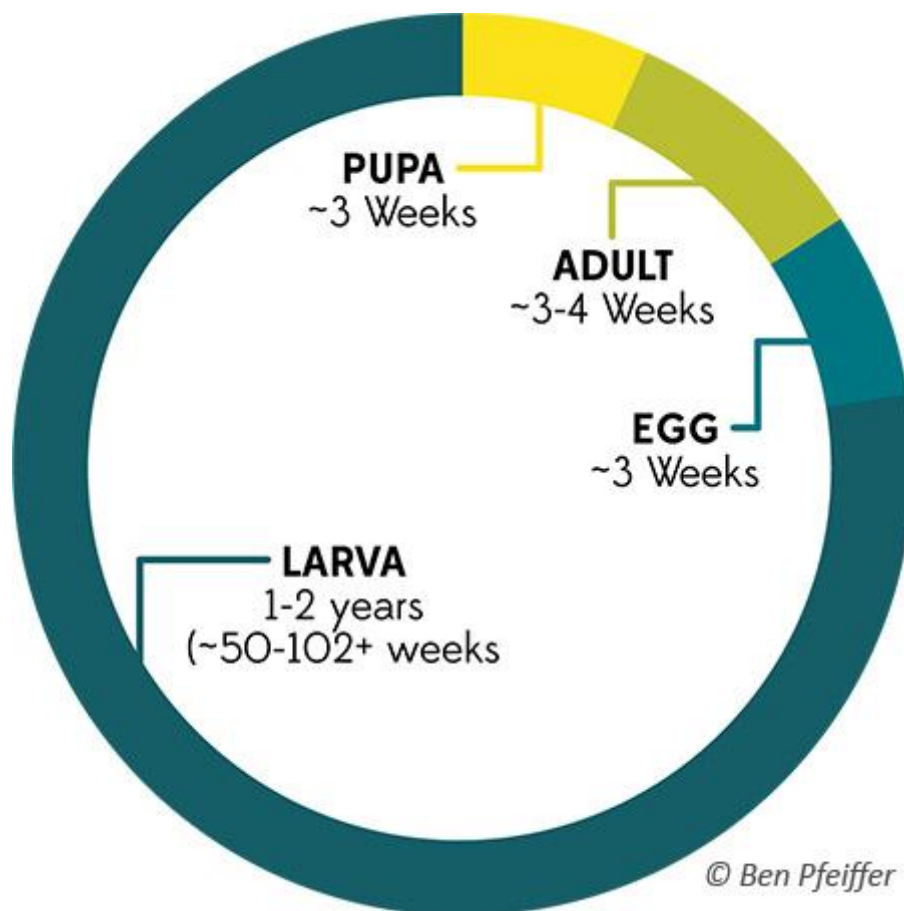
Thank you for taking the time to protect fireflies and for your support in this project.

Sincerely,

Ben Pfeiffer

Now, let's get started!

Understanding the Firefly Life Cycle



Like all beetles, fireflies undergo complete metamorphosis in four distinct stages: egg, larva, pupa and adult. An adult firefly lives only long enough to mate and lay eggs - usually only 2-4 weeks.

They may not need to eat during their adult life stage either. The larvae on the other hand usually live for approximately one to two years, from mating season to mating season, before becoming adults and giving birth to the next generation.

All stages of a firefly's life are important to protect, but larvae definitely deserve our attention as being one of the most important stages to protect.

Step 1 - Providing undisturbed cover for adults and glowing larvae

Fireflies are most vulnerable to disturbance during the larval stage and as adults during the mating season. These stages of development are the most critical to protect. Providing 'undisturbed' cover means not disturbing the vegetation and the ground where fireflies are active.

Get to know your habitat and the seasonality of your firefly species to inform you about the time periods you should work to limit disturbance. The time period could be as short as a few weeks to even a few months if you have multiple species in one habitat. Places with a rich diversity of species will require longer periods of protection because each species has its own unique time for emergence, pupation and mating.

Many species of fireflies are only active for 2-4 weeks in many places in the US over the course of a few months. In more southwestern locations like Texas, their mating season can occur during multiple times of the year such as in the spring/summer and fall.

Protecting Larvae

The most critical time for protecting habitat to protect larvae is in the late springtime to late summer. It's during this stage a firefly female will lay eggs in the mud or leaf litter in multiple different locations, and within 3 weeks the larvae will emerge from those eggs. It's at this point that the larvae are the most vulnerable as they are just starting to mature and grow larger.

Habitat disturbance at this time can have a detrimental impact to the survival of those larvae.

Larval fireflies are vulnerable to any human disturbance such as foot trampling from recreational usage, forest clearing, and man-made pollution. Mechanical disturbance should be avoided as well, with machines such as lawn-mowers to large earth movers such as tractors and bulldozers.

In your certified habitat, try minimize the following from May until August:

1. Land clearing and habitat disruption that disturbs the top soil surface. Larval development happens at ground level, so any activities that disrupt this area can affect firefly populations. This is especially important around riparian corridors or vegetation areas near rivers, creeks, waterways, or seeps. Do not use lawnmowers, weed-eaters, earth movers for construction or land clearing machines such as shredders, bulldozers, or other heavy machinery.
2. Pesticides usage. Avoid usage of broad spectrum pesticides or targeted pesticides toward beetles in your habitat during this time. If you use a pest control company, it is

highly advisable to pause or cancel your quarterly spraying at this time. Pest control technicians often broadcast pesticides in granular or liquid form in your environment for maximum effectiveness against nuisance insects. Rarely are they precise. Sometimes these insecticides can make it into your native habitats, gardens, and soil unintentionally. Those insecticides can affect non-target species such as pollinators, firefly food sources such as earthworms, snails, slugs, and other beneficial insects.

3. Light pollution. Turn off artificial lights at dusk and during active periods of firefly flight. Get to know when your local fireflies are active, and cut out those lights. Artificial light at night (ALAN) may be one of the drivers of firefly decline. Current evidence suggests that ALAN does have a demonstrable impact on firefly reproduction. Artificial light impairs their unique use of light signals to communicate and track females. It essentially gets in the way of them being able to see each other.

Step 2 - Encouraging plant diversity to preserve soil moisture

Fireflies are found in various habitats. Many species thrive along rivers, forests, fields and the margins between them. The one thing that is universal is the presence of some amount of moisture in those habitats, even if it's a small depression that holds water during firefly mating season.

Because of this, it's important to protect the vegetation in these habitats because they have the best ability to trap water in the soil by collecting, storing, and slowly releasing it. Grasses have extensive root systems that do a remarkable job of this. As the plant grows high above the ground, its roots can extend 3-4 times below that in the soil. This helps stabilize the soil, retain moisture more effectively and provide habitat for subterranean firefly larvae and the food they eat - snails, earthworms, slugs and other small insects.

Native plants found in your local area will do the best job for providing this habitat. In many ways, firefly species diversity is directly connected to a habitat's plant diversity and health. It's critical to protect this diversity.

In your certified habitat, try to do the following:

- Plant native plants in your habitat to encourage retention of water in your soil. Start with grasses, forbs, leafy shrubs, and hardwood species. Excellent firefly habitat will have a diversity of vegetation of different heights and texture and will have a scruffy appearance.
- Avoid shredding or mowing vegetation along riparian areas on either side of a river, creek, marsh, or seasonal wet area. This promotes healthy riparian plants that protect banks and beds from excessive erosion.
- Eliminate invasive species of plants that create monocultures of a single type of plant. These could compete with native species better adapted to the climate of your area to

harbor firefly diversity. If you have land with a water source, these plants' may also not be able to prevent bank erosion from seasonal flooding events.

- Encourage leaf litter to accumulate. Keep in mind that manicured gardens with heavy mulch layers are poor firefly habitat. While heavy mulch layers prevent weeds, they also prevent rainfall and nutrients from reaching the soil effectively. They also prevent firefly females from laying eggs directly in the soil and gets in the way of larvae accessing snails, earthworms, and other insects for food.

Understanding Habitat Degradation and Loss

Habitat degradation, loss and fragmentation are considered the largest threats to fireflies in the United States and Canada. They contribute to the overwhelming percentage of insect decline throughout the world as well. The primary drivers of firefly habitat degradation and loss are commercial and residential development, water pollution of rivers and creeks, and groundwater pumping. Habitat loss contributes to damaging complex ecological networks across the landscape. The effect of this damage is that it contributes to the disruption of its resilience to deal with climate or other forces that healthy ecosystems depend on to thrive and support a wide variety of plants and animals, including fireflies.

In general, most firefly species depend on moist habitats, including wetlands, streams, rivers and damp fields. Modification of these habitats can negatively affect firefly populations. Drought, disruption of water flows and diminishing water tables may also invariably affect species in more arid parts of the West.

In urban and suburban areas, lower native plant diversity and reduced leaf litter habitat required during larval stages is also a concern. Habitat loss can also be detrimental for species with flightless adult females, as those females can not disperse as easily beyond their isolated habitats.

Residential and commercial development also contribute to creating more fragmented habitats. For example, in the Eastern United States new housing developments, road construction, and retail developments have contributed to the loss of multiple fireflies populations over the years.

The same goes for regions experiencing exponential growth rates like Texas, where cities are pushing further outward into previously rural areas. Those rural areas are undergoing a land conversion from agricultural and ranch land to dense subdivisions and commercial areas. The soil is being stripped down to bedrock and replaced with concrete for homesites and asphalt for roads. Once a critical habitat is gone, it's gone for good.

Invasive Species

Invasive plant species are also decreasing plant diversity in native rangelands and riparian corridor areas. For example, the invasive grass Kleberg Blue Stem and King Ranch Blue Stem were originally introduced in 1940's and have rapidly spread across Texas. The grass is known for displacing other native grasses and creates a monoculture, or a single or very few plants growing in an area. This is not beneficial from a wildlife perspective, as the more diversity of plants present the more animal diversity an environment can support. The invasive grasses also create a dense "thatch" of dense leafy vegetation that prevents fireflies from accessing the soil either to lay eggs, provide cover or as cover itself.

Invasive animal species also contribute to degradation of native habitats by disrupting land that needs protection during critical periods of larval development or firefly mating. An example of this are wild pigs, who have a 'rooting' or 'wallowing' feeding behavior that disrupt land in riparian areas causing reduced habitat suitability for native species. They can also be a threat to water quality in riparian areas by introducing fecal material and disease-causing organisms.

Step 3 - Reducing Light Pollution

Artificial light at night (ALAN) may be one of the main drivers of firefly decline in the US and worldwide. Rapid technological changes in lighting sources over the last century have contributed to an increasingly brighter sky at night. 80% of people in North America can no longer see the milky way under even the clearest conditions, because it is obscured by skyglow.

Current evidence suggests that ALAN does have a demonstrable impact on firefly reproduction. Artificial light impairs their unique use of light signals to communicate and male's ability to track female flashes. It essentially gets in the way of them being able to see each other and if they can't see each other, they can't reproduce.

In your certified habitat, try to do the following:

Light Color

- Use warm yellow, amber or red colored LED lights. Amber colored lights with a yellow/orange hue occur in the 600nm-700nm range and do not interfere with fireflies light as much as other sources. Extended wavelength colors (yellow and orange) are less visible to insects, and most of them can't see the red light at all. Scientists have discovered these lights also have the benefit of attracting less "other" bugs to outdoor lights as well.
- It's good to remember that bright bluish white LED lights emit a spectrum of light (430-700nm) that washes out most colors of light, including the spectrum of light used by fireflies in the yellow-green spectrum (475nm – 670nm) to signal to one another.
- Avoid using incandescent light bulbs, CFL, halogen globes, and cool-coloured LEDs directly in your firefly habitat.

Best Practices

1. Turn out lights you are not using!
2. Turn off as many outdoor lights as you can.
3. Remove lights that are only for decoration, such as tree lighting and facade lighting.
4. Install motion sensors to switch off your lights when no one is nearby.
5. Install timers to turn off your lights when you are not likely to be around or when fireflies are active, which is from dusk to several hours later.
6. Install shielding around your lights to keep light from escaping into the sky or away from firefly areas with native plants and vegetation.
7. Dim your lights and install lighting fixtures that point downward.
8. Close your curtains at night so light doesn't escape in the surrounding areas

Step 4 - Restrictions on pesticide usage

Pesticides such as insecticides and herbicides have been linked to the loss of several insect species, including fireflies. While there is little research on the direct impacts of pesticides on fireflies, research on similar species and firefly prey, as well as observations by firefly researchers, can provide insight into their sensitivity.

Because the majority of firefly species spend the majority of their lives as larvae devouring snails, earthworms, and slugs, pesticide effects on these food sources are likely to have a negative impact on fireflies. Herbicides may also have an indirect effect on firefly populations by removing vegetation required for shelter, operational cover, mating, and overwintering.

Pesticides can be ingested by fireflies in a variety of ways. Direct application in their habitats, runoff from agricultural or domestic applications, or eating of contaminated prey are all possibilities. Because of their reliance on moist habitats, they are vulnerable to pesticides that move through the water.

Insecticides meant to kill insects, specifically beetles, are the chemicals most likely to cause direct harm to fireflies. These include broad spectrum insecticides, which are designed to kill insects indiscriminately, regardless of species. Neonicotinoids and organophosphates are two examples. While research on the direct effects of neonicotinoids and other insecticides on fireflies is limited, studies on other beetle species can provide insight into the possible harm they cause fireflies.

Neonicotinoids are extensively used in residential settings to control white grubs (the larvae of numerous beetle species) on lawns. Over several years, the use of imidacloprid, a kind of neonicotinoid, was found to reduce non-target species such as beetles by 50 percent or more. Some researchers suggest that spraying residential lawns for white grubs can eliminate fireflies in those habitats.

In your certified habitat, try to do the following:

- Eliminate broad spectrum pesticide usage in firefly habitat and in adjacent areas.
- If you use a pest control company, it is highly advisable to pause or cancel your quarterly spraying at this time. Pest control technicians often broadcast pesticides in granular or liquid form in your environment for maximum effectiveness against nuisance insects. Rarely are they precise. Sometimes these insecticides can make it into your native habitats, gardens, and soil unintentionally. Those insecticides can affect non-target species such as fireflies and other beneficial insects.
- For rural land managers and agricultural areas, identify what pest management strategies you are using to control against nuisance insects. Read the labels closely and get specifics on the types of pesticides you use. Take steps to prevent these chemicals from being used in riparian corridors and near water sources.

Acknowledgements

Thank you to Firefly Conservation & Research donors and supporters, because of your generous contributions this project is possible. Thank you for allowing me to make an idea into a reality.

A big thank you to [Alopex Interaction Design](#) in Palmer, Alaska who worked with me closely to create the sign design.

Special thank you to Lynn Faust, author of Fireflies, Glow-worms, and Lightning Bugs for her advice with help crafting the sign language.

Recommended Reading

The following publications are highly recommended for further study on firefly conservation efforts and studies on their disappearance.

Conserving the Jewels of the Night

<https://www.xerces.org/publications/guidelines/conserving-jewels-of-night>

Conserving the Jewels of the Night: Firefly-Friendly Lighting Practices

<https://www.xerces.org/publications/fact-sheets/firefly-friendly-lighting>

[Fireflies, Glow-Worms, and Lightning Bugs by Lynn Faust](#) (2017) provides identification and natural history of the fireflies in the eastern and central United States and Canada.

[Silent Sparks: The Wondrous World of Fireflies by Sara Lewis](#) (2016) offers an introduction to the science and wonder of fireflies.

